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THESIS

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NAVAL POSTGRADUATE SCHOOL
Monterey, California

DEPARTMENT OF THE NAVY

THESIS

HEAT TRANSFER FROM AN ARRAY OF HEATED RECTANGULAR ELEMENTS ON AN ADIABATIC CHANNEL WALL

by

David W. Mears

December 1986

Thesis Advisor Allan D. Kraus

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Heat Transfer From An Array of Heated Rectangular Elements On An Adiabatic Channel Wall

by

David W. Mears
Lieutenant Commander, United States Navy
B.S., U. S. Naval Academy, 1975

Submitted in partial fulfillment of the
requirements for the degrees of

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ABSTRACT

This thesis describes an experimental study to determine the heat transfer characteristics of rectangular elements mounted on an adiabatic wall in a laminar air flow. The study involves forced convection and the determination of the heat transfer coefficients as influenced by the unheated elements. The study is timely in that major concern is the understanding of removal of the generated heat from electrical equipment and electronic devices which utilize microelectronic chips.

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TABLE OF SYMBOLS AND ABBREVIATIONS

A	Constant in the smooth law of the wall.
B	Characteristic dimension of cubical blocks.
C	Constant in roughness function.
$C_f/2$	Local skin friction coefficient.
d	Pipe diameter, or distance between channel walls.
e	Some arbitrary characteristic height of roughness.
e^+	Roughness Reynolds number based on e.
g^+	Heat-transfer similarity function, Eq. (1.4).
H	Distance between channel walls.
hb	Designation for heated block.
h	Local convective heat transfer coefficient.
h	Area average convective heat transfer coefficient.
k	Conductivity of the fluid.
k	Roughness height.
L	Test section channel length.
N	Row position number in the array.
Nu	Nusselt number.
P or p	Pitch of repeated roughness geometries.
Pr	Prandtl number.
q	Power input from electrical resistance heating.
R^+	Friction-similarity or roughness function.
Re	Reynolds number.
$R^+(\infty)$	Roughness function constant for a fully rough flow.
$Re^+(k)$	Roughness Reynolds number based on equivalent height, k.
S	Spanwise and streamwise characteristic dimension of regular array.
St	Stanton Number.
T_{hb}	Temperature of the heated block.
T_∞	Freestream temperature.
$T_{element}$	Final temperature achieved by an element in the array.
u	Downstream direction velocity.
u_b	Bulk mean velocity.

u_τ	Frictional velocity.
$\underline{V}$	Velocity vector.
u^+	Dimensionless velocity, u/u_τ.
$\Delta u/u_\tau$	Roughness function = R^+, defines shift of the rough-wall log region from the smooth wall behavior.
α	Thermal diffusivity.
δ	99% thickness of the momentum boundary layer.
κ	Von-Karman constant.
ρ	Fluid density.
θ	Dimensionless adiabatic element temperature (temperature of passive elements in wake of a single element being heated in the array).
$\theta(R1)$	Dimensionless temperature of the element directly behind the heated block.
τ_o	Shear stress at the wall.
ν	Kinematic viscosity.
ν_e	Equivalent kinematic viscosity.

I. INTRODUCTION

A. DESCRIPTION OF THE PROBLEM

Over the past decade, recent advances in electronic systems have given rise to the challenging problems in applications of advanced heat transfer techniques to electronic equipment cooling. This study models forced convection cooling of electronic components on vertically oriented circuit boards where adjacent boards form channels, with one surface being relatively smooth, and the other populated by an array of large, heat dissipating elements. This research is of immediate practical interest to the electronics industry because cooling of electronic components has become increasingly important as power dissipation and component densities continue to increase in each new generation of electronic devices.

One method of electronics cooling is for a small cooling fan with a small capacity to blow or induce a flow of cooling air over a high density array of micro-electronic components mounted on a bakelite or epoxy board. This type of cooling offers low cost, high thermal reliability and an absence of noise. There is a desire in this study to understand the relation of rough walled heat transfer and the structure of flow in the near-wall region, it's conditions and it's relation to the separated flow heat transfer around bluff bodies.

This research, with it's practical relationship to the technical problems in the electronics industry, derives from the work in heat transfer from cubical elements done at Stanford University. This study extends the data base from cubical elements to rectangular low-height elements.

Printed curcuit boards exhibit great variabilities in size and shape of components, and the way in which the components are arranged, as shown in Figure 1.1. Most geometries resemble plane surfaces with varying degrees of roughness which may be random in size and shape. The present study attempts to relate the heat transfer behavior of large rectangular heated elements in an array mounted on one wall of an adiabatic channel to the concepts of sub-layer Stanton numbers found in the literature for small scale rough wall theory.

There are many distinct methods available for mounting and inter-connecting electronic components and one of the most popular is the printed circuit board (PCB).

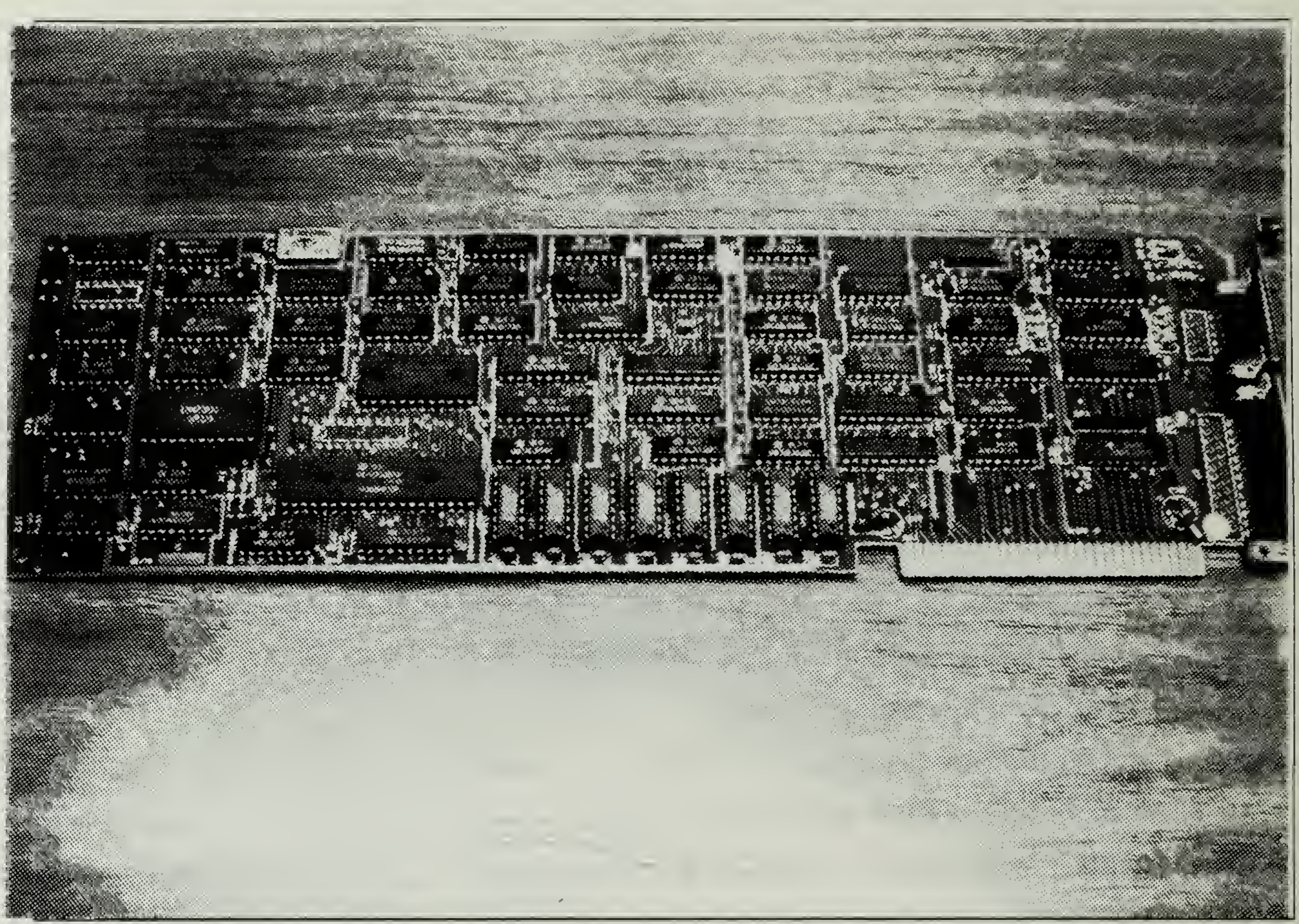

Figure 1.1 Photograph of a Printed Circuit Board for a Personal Computer.

This is a representative sub-system upon which arrays of heat dissipating electronic components are mounted. Components may be semi-regular in geometry as for example VLSI chip carriers, Dual-In-Line Packages (DIPS), and Single-In-Line Packages (SIPS), or they may be irregular shaped components on a board such as resistors and capacitors.

The distribution of components on a circuit board is application dependent, but frequently components are mounted "in-line" in the direction of the coolant flow. Space considerations often dictate PCB's to be mounted vertically in system racks and if multiple PCB's are utilized, they may be back to back in horizontal racks. Figure 1.2 shows a typical card stack in which many printed circuit boards, each with an array of hot components deployed on one side, are arranged to form long semi-continuous vertical channels, open at top and bottom for natural or forced ventilation.

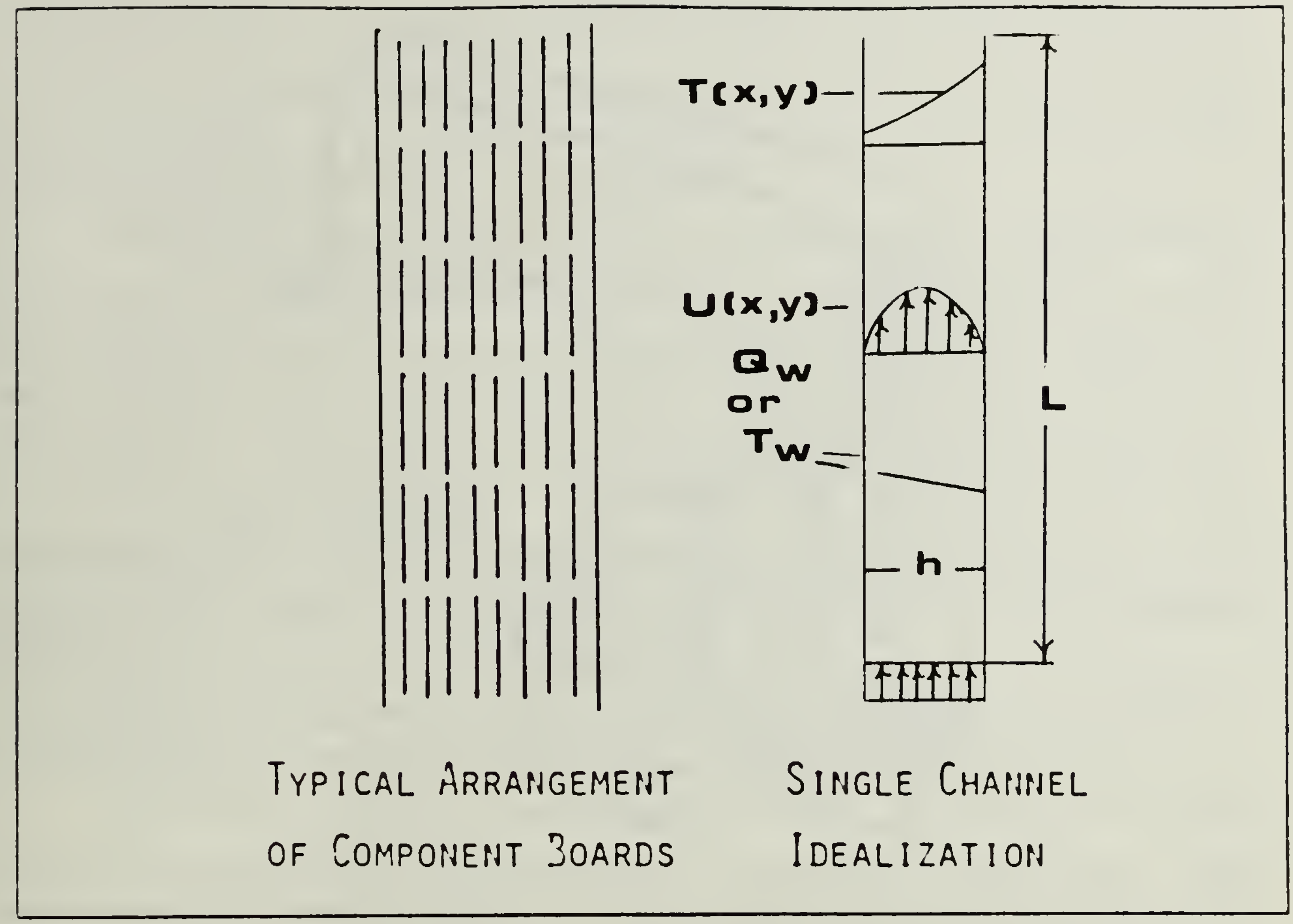
T(x,y)
U(x,y)
Q_w
or
T_w
L
h
Typical Arrangement of Component Boards
Single Channel Idealization

Figure 1.2 Typical configuration of printed circuit boards in rack and cabinet.

The present study is concerned with this type of configuration. The flow is induced through the arrays by a fan and ejected at the top. The heat-transfer surface has two characteristics: 1) heat dissipation is mainly from discrete sources on a plane surface, and 2) the sources are three-dimensional protrusions.

In order to study the problem, idealizations, as shown in Figure 1.3, have been developed. Array geometry is described by element shape and spacing, S, the wall to wall spacing, H, and the channel length, L. In order to remove geometric variabilities, rectangular elements were chosen to model Dual-In-Line Packages (DIPS). If B is the minor rectangular length scale, the geometry can be completely specified in terms of S B, H B and L/H.

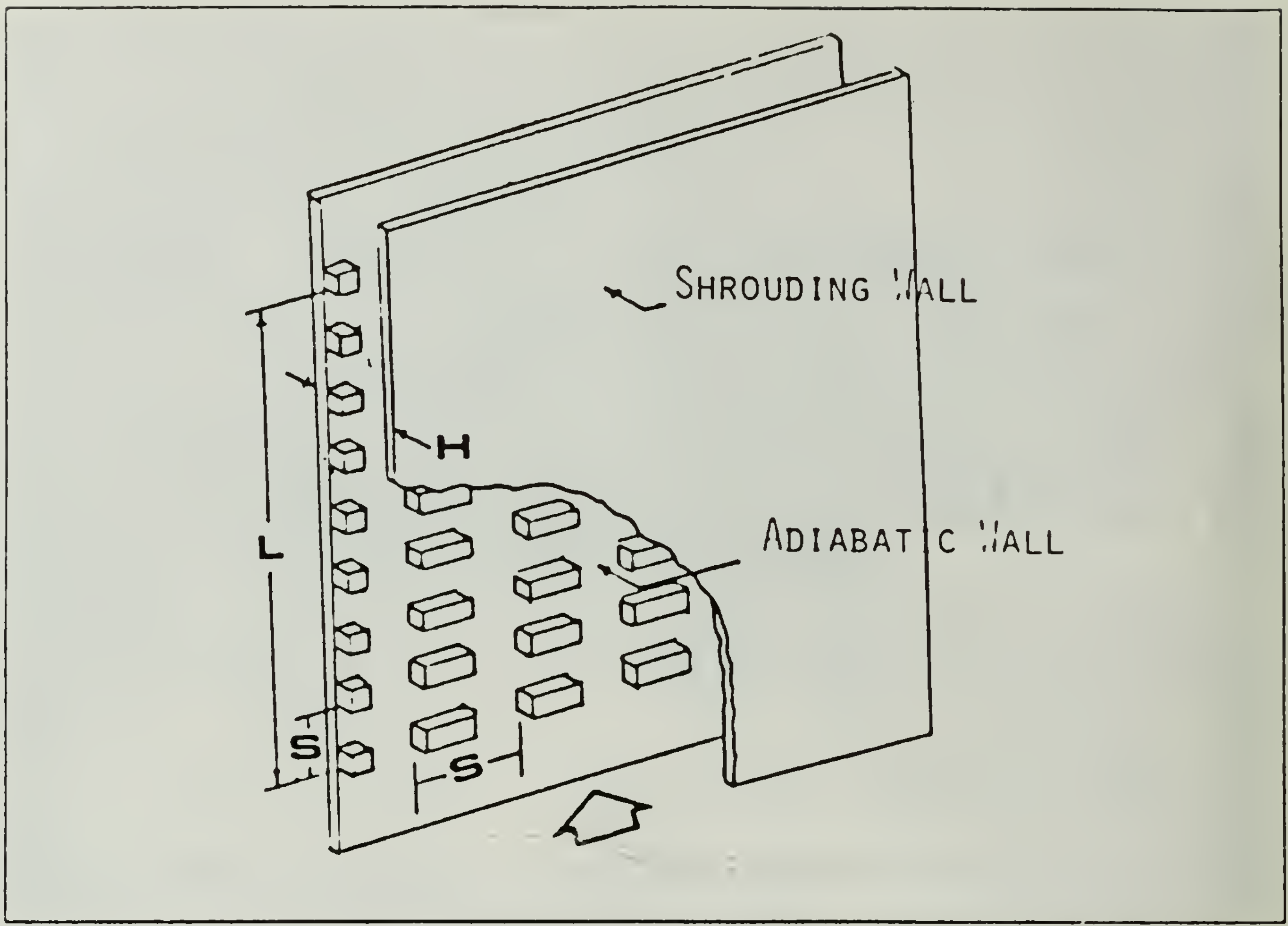

Figure 1.3 Test channel for present study, 1/2 inch x 1 inch low profile rectangular elements spaced at S/B = 1.0 with 5 full columns, 2 half columns and 9 rows..

B. PREVIOUS RELATED WORK

1. Electronics Cooling by Forced Convection

Several factors are taken into account when analysing a heat-removal system. Among these are the operating characteristics of the components themselves, the requirements of the electronic system designer with respect to component layout, and the operating environment of the system. Even if this information could be assimilated in guidelines, the packaging designer would still need a technique which would allow him to predict the thermal performance of the components. For the cooling of such geometries, there have been many attempts at the development of techniques, but success has been restricted to specific geometries. Trial and error is usually the basis for the successful development of the electronic modules.

There are two predominant areas of modeling. The first is the case of modeling small portions of the problem by finite elements. Heat transfer from an element in an array on a PCB is a complex process. Heat is conducted from the component to it's carrier circuit board, convected to the cooling air flow, and radiated to it's surrroundings. The opposing board delivers heat, by conduction, into the flow channel from elements located on it's other surface.

By the use of finite element representation, elegant codes have been developed to compute the conduction and radiation interaction. The majority of these codes have been developed in the private sector, but some have been in the public domain. The book by Kraus and Bar-Cohen [Ref. 1] includes sample codes of this type where the convective heat transfer ultimately is handled by specifying the convective conductance, or the heat transfer coefficient, from the surface nodes to the cooling fluid. The specification of this surface conductance usually entails some experimental data from the prototype in question, along with standard correlations for highly simplified geometries with well known boundary conditions.

The major problem lies with the capabilities of the modern computer to handle enough of the problems to give the packaging designers practical input.

The second and most common category is the case where the physical situation has been reduced to an analytically or numerically tractable model. Many times the model no longer reflects all of the features of the actual situation, and subsequently piecewise improvements must be made. Most of the current modeling efforts are beginning to resemble the physical situations. There are still large strides to be taken before a true representation of the typical configuration can be made. Note that in both natural and forced convection the same details of flow behavior must be studied. It is possible to develop simplified models of forced convection but natural convection is much more difficult. With these observations it is not surprising to find that the literature typically presents empirical or semi-empirical approaches. Care must be taken in assessing the generality of most techniques since they quite frequently apply only within specific data base.

One summary concerning this topic was presented in the concluding remarks of the Directions of Heat Transfer in Electronics Equipment Research Workshop by A. D. Kraus [Ref. 2]. It is partially repeated here:

> The problem of heat transfer in electronic equipment is readily admitted to be very complex and worthy of attention. The complexity is a result of many factors. Perhaps the most important of these is that the rapidly changing and highly competitive technology results in a vast multiplicity of complex physical configurations. Another general aspect of complexity is the first-order coupling of several physical phenomena. For example, it is usually not possible to

separately consider conduction, convection or radiation as separate modes of energy transport in electronic equipment. These modes are often inextricably tied together, along with additional complexities. Even an accurate formulation is often not possible. Simplifications lead to more tractable formulations, but, of course, do so at the expense of reduced accuracy. One faces here, the age-old problem of casting the results of the investigation of complex phenomena into easy-to-use form. It may be true that the development of simple design techniques for sufficiently complex phenomena is just not possible, although highly desirable. In any event, however, the attainment of such a goal would lead to great efficiency in design and operation of electronic equipment.

The attainment of this goal is made difficult by the fact that many of the most fundamental aspects of heat transfer in electronic equipment are not well defined. For example, it is often not clear whether the flow of air in card arrays is laminar, turbulent or a flow undergoing transition. Indeed, it may be a "meandering" laminar flow. Another example is the difficulty of making an accurate assessment of mixed convection effects. It is necessary to define such factors as a first step, if increased accuracy is to follow from increased understanding.

Heat transfer groups in both the electronics industry and at universities are concerned with thermal aspects of electronic equipment but each has different missions and constraints. Industry is certainly bound much more by practical constraints such as time deadlines and cost limitations. An overriding mission is to "get it to work," whether or not all of the fundamental details are understood. On the other hand, great improvement and efficiency in design and operation could perhaps be realized if the fundamentals were better understood. In university research, however, problems are often defined so as to make them "do-able" rather than what really needs to be done and in the process, reality tends to be obscured. When real-world constraints are imposed, the results are often inapplicable because important complexitities are ignored.

C. BACKGROUND OF ACKNOWLEDGED DIFFERENCES DUE TO SURFACE ROUGHNESS GEOMETRIES

1. With Regard to Friction Behavior (k vs. d type)

Surface roughness has been classified into two general categories, two dimensional or three dimensional. (See Figure 1.4 for representation of two dimensional and three dimensional, rectangular type roughness.) These categories have further been divided into "artificial roughness" vs. "commercial roughness." As Schlichting [Ref. 3] points out, these surface subclasses often behave differently. To amplify the definitions, sand-grain roughness is of the three dimensional type, normally closely packed and spherical in shape and may be of the artificial or commercial subclass. Ribbed roughness is a representation of the two dimensional artificial type. Rib shape and pitch ratio further classify ribbed roughness.

The d - or - k type roughness classification is in use by researchers as a scheme for surface roughness description. The next few paragraphs summarize the classification scheme for k - and - d type roughness in the literature.

The framework of rough-walled flow analysis was established by Nikuradse [Ref. 4] who experimented with flow in sand roughened pipes. His experimentation led

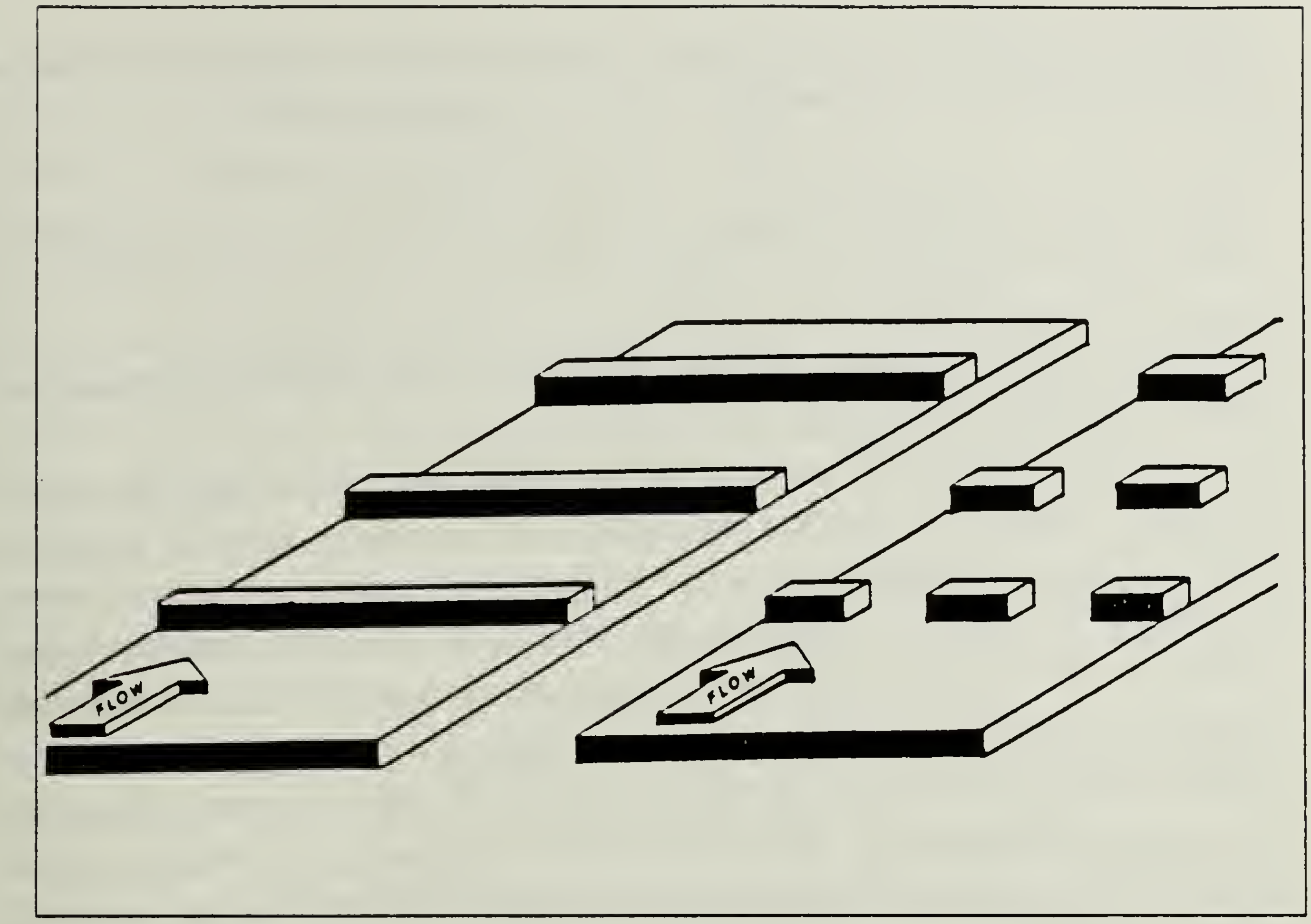

Figure 1.4 Rectangular roughness geometry, two dimensional vs. three dimensional..

to relationships between the flow behavior and the relative roughness scale k/d (k is the roughness scale and d is the pipe diameter) as well as the Reynolds number. Nikuradse's work led Clauser [Ref. 5] to form the logrithmic velocity distribution for flow over rough walls.

$$\frac{u}{u_\tau} = \frac{1}{\kappa} \ln \left(\frac{y u_\tau}{\nu} \right) + A - \frac{\Delta u}{u_\tau} \qquad \text{(eqn 1.1)}$$

In this equation $u_\tau = \sqrt{\tau_0/\rho}$, with τ_0 = the wall shear stress and, ρ = fluid density. The roughness function $R^+ = (\Delta u/u_\tau)$, which is zero for smooth walls. κ and A are universal constants. Equation 1.1 can be written for smooth walls as:

$$\frac{u}{u_{\tau_0}} = \frac{1}{\kappa} \ln \left(\frac{y u_\tau}{\nu_e} \right) + A \qquad \text{(eqn 1.2)}$$

Hama [Ref. 6] showed from results of an extensive experimental program that equation 1.1 and the Clauser form of roughness function for fully rough flow,

$$\frac{\Delta u}{u_\tau} = \frac{1}{\kappa} \ell n \left(\frac{k u_\tau}{\nu}\right) + \text{constant} \qquad \text{(eqn 1.3)}$$

are both universal for a given roughness geometry in a pipe, channel and zero pressure gradient boundary-layer flow.

Arvizu [Ref. 7: p. 7], summarized Perry's [Ref. 8] test to determine the relative roughness function. To illustrate the method, first consider a graph of C_f plotted against ℓn Re for a smooth pipe in turbulent flow. Here both C_f and Re are based on the bulk mean velocity u_b. Now, from equation 1.2, note that the rough-wall velocity profiles can be collapsed onto the smooth-wall results by relacing ν by some equivalent viscosity, ν_e. It follows, therefore, that a rough-wall friction factor versus Reynolds number curve for constant ν_e is identical to the smooth-wall curve with ν replaced by ν_e in the Reynolds number. Hence the curves of constant ν_e/ν in the C_f vs. ℓn Re graph are simply the smooth-wall friction factor graph shifted sideways by a factor ℓn (ν_e/ν). Equation 1.2 also shows that these curves are also contours of $\Delta u/u_\tau$. By plotting experimental data on this graph, it is possible to read off the appropriate value of $\Delta u/u_\tau$ and to calculate the product $Re\sqrt{C_f/2} \times (k/d)$, or simply $Re^{+}(k)$. Note that C_f can be determined by force or pressure measurements. One then plots $\Delta u/u_\tau$ vs. $Re^{+}(k)$. If a correlation is found to exist, then it is stated that the roughness function depends on the height k and this roughness geometry is called k-type roughness. If instead it correlates on $Re\sqrt{C_f/2} = du_\tau/\nu$, then it is classified as d-type roughness, referring to its dependence on the equivalent pipe diameter. For the equilibrium boundary layer in zero pressure gradient, the correlation height has been shown by Perry [Ref. 8: p. 390], to be the boundary-layer thickness, δ.

Sand grain geometry has been verified to be of k-type and further correlated by Clauser's roughness function form [Ref. 7: p. 8]. Studies of ribbed two dimensional roughness geometries have also made it apparent that the roughness parameter can also be correlated with k, the roughness height. Closely spaced ribbed roughness, i.e. $P/K \leq 2$ however is one of d-type roughness.

Arvizu [Ref. 7: p. 9], summarized the data concerning the roughness function R^{+}. With ribbed roughness pitch ratio the roughness ratio reaches a constant value, i.e. $R^+(\infty)$, for high values of $Re^+(k)$. Sand grain and several other roughnesses have been experimentally observed. A curve of $R^+(\infty)$ vs. P/k ratio for ribbed roughness is constructed as shown in Figure 1.5 [Ref. 7: p. 21]. This curve shows a marked difference in the $Re^+(\infty)$ behavior for the two distinct pitch-ratio ranges given by values above and below a nominal value of P/k ~ 8. This suggests that pitch ratios in the range of seven (7) to ten (10) fall in the transition region between two different roughness function behaviors. Further, a surface has the highest St and C_f when P/k ratio is seven (7) to (8). Studies of the pressure distribution around rectangular finned surfaces for various pitches have divided the loss into two components, friction and form drag. It is concluded that friction losses are at a minimum at P/k of about ten (10). At P/k ~ 8 to 10 flow reattachment to the bottom of the wall downstream of the separated shear layer over a rib occurs. This flow behavior represents an independent event and is significant in determining k or d type behavior.

Only a handful of researchers use the terminology of k and d type roughness. The general concensus is not apparent, but many allude to the characteristics of these classifications. This thesis is not concerned with the small grained roughness, but rather with large roughness compared with scale of the measurement probe. In this experiment the boundary layer is disturbed to the point of turbulence within the array.

2. With Regard to Heat Transfer

The development of the equivalent heat-transfer roughness parameter, g^+ is an extension of the friction-factor roughness parameter, R^+ development. There are several assumptions needed. The interpretation of g^+ is commonly referred to as the inverse of a sublayer Stanton number

$$g^+ = 1/St_{sublayer} = C_1(e^+)^p(Pr)^q \qquad \text{(eqn 1.4)}$$

The constants p and q fall into two categories:

1. Assumption ofsimilarity of the profiles near the wall results in $p = .2$, $q = .44$.
2. Assumption of breakdown close in to the wall leads to the neglect of the roughness subsequently $p = .45$ and $q = .57$.

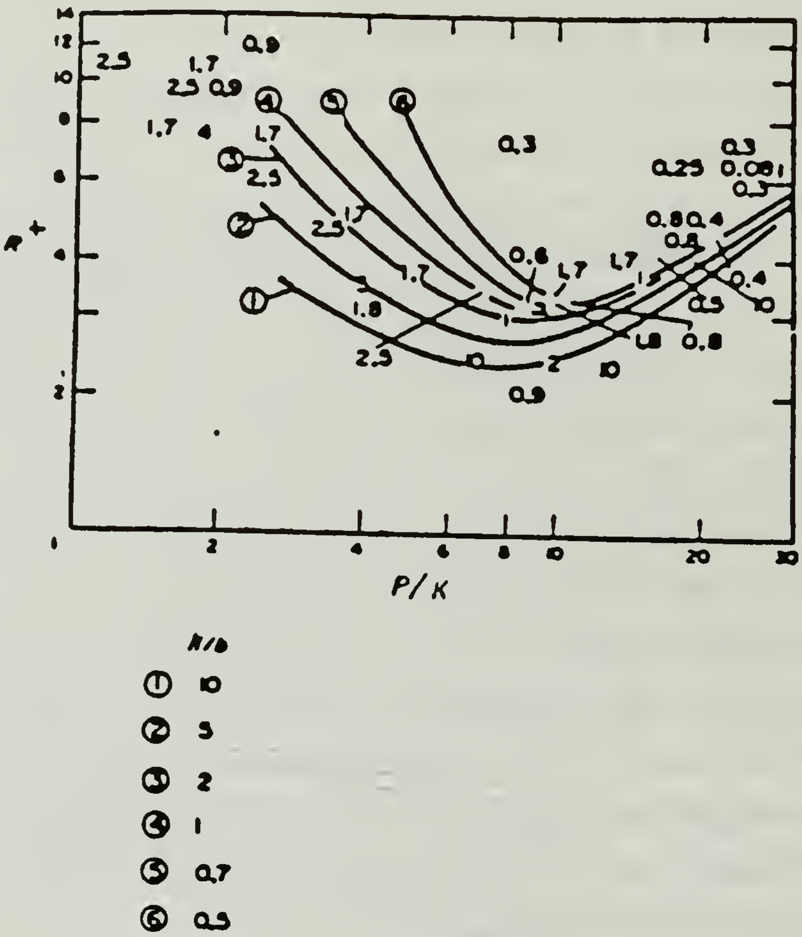

Figure 1.5 Roughness function vs. pitch ratio for rectangular ribbed roughness.

D. THE RESEARCH PROBLEM

1. Objective

The discussion of the previous sections showed the two areas of concern in this study. The first was the more practical nature of determining heat transfer coefficients to sophisticated techniques in determining the temperature distribution by modern computer codes. The second area was to look at the surface roughness area.

This research was more concerned with the practical applications by studying the convective aspects of the circuit pack problem, utilizing an adiabatic wall (similar to epoxy-glass circuit boards commonly used). The necessary radiation and conduction corrections were made to the model. A specific geometry was selected in order to model present technological trends. Isolating a particular geometry for study, i.e., the regular rectangular element, allows the program to fit nicely into the study of classical small scale roughness theory, since geometry length can be easily described. With these intentions, the following objectives have been defined.

1. To develop a model of a circuit board and forced convection apparatus using regular rectangular elements as the geometry.
2. To develop methods for calculating the temperature distribution in a regular array of arbitrarily heated rectangular elements on an adiabatic wall in a channel.
3. To compare the heat transfer behavior to previous work in this area by Arvizu, Ortega and Piatt. [Refs. 7,9,10]

2. Approach

The approach taken was to conduct an experimental study paralleling the study of forced convection in cubical arrays by Arvizu [Ref. 7: p. 17-19]. The model geometry is as shown in Figure 1.3. It consists of an array of rectangular elements mounted on a nearly adiabatic wall. There will always be an opposing smooth wall. The opposing wall and channel sides are thus impermeable.

The geometry chosen for study, were 1/2″x1/2″x1″ rectangular elements in a relatively sparse in-line array. This geometry and arrangement was intended to resemble the flat geometry and configuration presently used in electronic equipment. This geometry does retain two important features which cannot be ignored: The heating takes place on discrete locations of the surface of the array and these locations are three dimensional protuberances of a particular geometry.

For this study, use was made use of the superposition principle used by Arvizu [Ref. 7: p. 18]. Arvizu considered a regular array of passive elements with the exception of a single heated element. This element causes energy to be convected to the elements within the wake of the downstream airflow causing their temperatures to rise. These temperatures represent the adiabatic temperatures of passive elements.

For this study, only elements in the same column as the heated block were considered. In this way, the assumption was that the governing equations were linear. The adiabatic temperatures were calculated by simply adding the contributions from each of the two elements. Thus, adiabatic temperatures could be determined by adding or superposing the contributions from each of the upstream heated elements. The contributions from an element five rows upstream would be different from that of one located one row away. Therefore, it was necessary to determine the entire thermal wake profiles of the column elements. Furthermore, it was expected that the thermal wake profiles would be functions of the previously mentioned parameters, i.e. H B, S B, position in the array,and mass flow rate.

Once the adiabatic temperature of an element has been determined, it´s temperature rise above adiabatic temperature could be calculated from a knowledge of the heat transfer coefficient and its heat dissipation. It was also expected that the heat-transfer coefficient also would be a function of all the parameters of interest.

The approach taken was similar to the one taken by Arvizu [Ref. 7: pp. 17-19]. Heat-transfer coefficients for each position in the column were determined experimentally (by heating each element individually and measuring the temperature rise) as a function of channel-height ratio, and mass flow rate. As each element was being tested, the column wake profile was also determined by measuring the temperature of the downstream elements. Then, all heat transfer parameters and constants were calculated and analysed for trends.

II. APPARATUS AND INSTRUMENTATION

A. INTRODUCTION

The experimental apparatus was designed to measure the heat transfer rates from each element in an array of rectangular elements mounted on a vertical surface with an opposing vertical surface in a forced flow. The objective to obtain was an extension of heat-transfer data of Arvizu [Ref. 7: pp. 35-40], to a different shape than his cubical elements. All equipment was manufactured by the Engineering Department of the Naval Postgraduate School, Monterey, California. Most aspects of the design and instrumentation reflect the space and budget allocations for this experiment.

B. WIND TUNNEL

The measurements for the experiment were taken in a draw through open-loop wind tunnel with a vertical test section Figure 2.1. The tunnel intake bell with an eighteen (18) inch radius of curvature has an orifice crossection of forty (40) inches by twelve (12) inches. Adjustable legs are attached at each corner to serve as supports, provide an eighteen (18) inch clearance off the floor and level the tunnel. The intake section was constructed of one-eighth (1/8) inch plexiglass. One inch reinforcement plexiglass was attached to the exterior to provide additional support to the test section.

The test section, Figure 2.2, was constucted of one-eighth (1/8) inch plexiglass with the exception of access and mount plates made of one-quarter (1/4) inch plexiglass. The test section channel has a four (4) inch by twelve (12) inch crossection with a height of eighteen (18) inches. A pitot-static tube was mounted on the access plate opposite the test surface to measure the free stream velocity over the test plate.

The top of the wind tunnel was reduced to a section of two (2) inch PVC ducting which was connected to a 550 scfm turbo-fan compressor, Figure 2.3. Air flow through the tunnel was controlled by a series of valves connected in line with the flow.

The access plate opposing the test surface has a splitter plate mounting to offset any boundary layer formed between the bell inlet and the test section. The distance was predetermined by use of computer software [Ref. 11] and is displayed in Figure 2.4.

To eliminate the effects of incident radiation, a wooden frame box (4′x4′x8′) was constructed around the wind tunnel. The box also served to reduce any transient air currents created by movements in the room (i.e., doors opening and closing).

The primary test section, Figure 2.5, was modified to accept the test plate mounted on four screws. The screw mountings offered the means by which the test channel height could be varied within the test section. It was not an objective of this investigation to study effects of inlet conditions such as boundary-layer thickness and free stream turbulence. It was desired only to maintain a uniform free-stream core velocity. In order to maintain clean parallel flow (i.e. no separation) at the leading edges of the splitter plate and test surface, it was necessary to match the flow resistance in each of the three seperate flow channels. Each time the test plate was adjusted, this flow matching had to be performed. Matching was checked by means of a wool thread inserted into the flow path. The thread indications were subjective, but found to be a dependable method to determine if leading edge seperation had occured. The flow resistance matching was accomplished by a four (4) inch plexiglass flap mounted on the downstream edge of the test surface see Figure 2.2. A hot wire anemometer was mounted upstream of the test surface. The hot wire anemometer was used to probe the channel checking for uniform air flow entering the test section.

C. TEST SURFACE

The design of the test surface was inspired by the test surfaces used by Arvizu [Ref. 7 pp. 33-40], and Ortega [Ref. 9: pp. 25-30]. The test surfaces were constructed of a 12″x18″x3/8″ sheet of balsa wood (adiabatic surface) cemented to a 12″x18″x1/8″ sheet of plexiglass. The leading edge of the balsa wood-plexiglass test surface was cut at a thirty-five (35) degree angle to form a sharp leading edge, reducing the effects of leading edge separation. The balsa wood surface was sanded and painted with one coat of aluminum heat resistant paint and five coats of white enamel paint. The white enamel paint was sanded between each application to ensure a smooth test surface. Small (1/16″ diameter) holes were drilled to permit the access of thermocouples and resistor leads into the rectangular elements mounted on the face of the test surface. Three mounting screws were attached to the plexiglass plate and to the access plate which were utilized in the positioning of the test surface.

1. Elements

The array, Figure 2.6, consists of nine rows of five complete elements and two half elements mounted at the ends of each row. Rows were spaced at one half (1/2) inch intervals with the columns having a one inch spacing. The first row of elements was located four (4) inches from the leading edge. The elements used in this study were aluminum rectangular prism nominally 1/2"x1/2"x1". Each element in the array could be heated separately and had one embedded thermocouple for temperature measurement. The heater consisted of a one ohm, one watt resistor. In order to minimize thermal conduction through the power leads, the normal resistor leads were trimmed almost flush to the resistor body and replaced with fine AWG-20 gauge wire leads soldered to the remaining stubs. The resistors were potted in a 3/16" diameter hole in the element with Thermal Epoxy so that only the fine leads protruded from the base of the element. Element temperature was monitored with 20 AWG Type T thermocouples potted in a 3/8" deep well with a 1/32" diameter using a general purpose glue (super glue).

The 3/8" well depth was selected to insure thermocouple wires were embedded to a minimum of fifty (50) wire diameters to produce negligible conduction error in the thermocouple signal. After assembly, the elements were cemented to the test surface with the same glue used to pot the thermocouples. The heater leads and thermocouples were fed through the board holes drilled in the pattern of the heater and thermocouple leads. The heater and thermocouple leads were further fed through single access holes located in the access plate for eventual hookup to the heat input control patch board and the temperature instrumentation.

D. INSTRUMENTATION

1. Temperature Measurements

Type T copper constantine thermocouples were routed through an access plate in the wind tunnel test section through the test plate and potted in each element. The thermocouples were connected to six scanner boards in an Autodata Nine. The Autodata Nine is a self contained, 100-channel data recording device, Figure 2.7. Channels were on ten (10) wafer style boards so the master unit could be used to measure voltages or temperatures with the appropriate value taken directly as output. For this equipment, fifty-eight (58) channels were configured for direct read out in Fahrenheit. All fifty-eight (58) thermocouples and the Autodata Nine were calibrated as a system to an accuracy of ± 0.2° Fahrenheit. (Appendix A)

2. Hotwire Anemometer

The Hotwire Anemometer and associative equipment consisted of five major items:

1. Hotwire probe, Figure 2.2
2. Resistance Bridge, Figure 2.7

3. Amplifier Filter Display Unit, Figure 2.7
4. Oscilliscope, Figure 2.7
5. Micro-manometer, Figure 2.9

A TSI (Model 1050/1050AA) hot wire anemometer was used to determine the velocity profile prior to entry into the test section. The hot wire anemometer was calibrated with the micro-manometer and used only to ensure that the approach velocity was uniform.

3. Velocity Measurements

Measurements of the flow rate through the test section were obtained by a micro-manometer and a pitot-static tube. The difference between the dynamic and static pressure was measured by the micro-manometer. The pitot static tube was mounted on the access plate opposite the test surface (see Figure 2.5). Accuracy of the micro-manometer was determined to be ± 0.0005 inches of water which translates to an error of ± 0.2 ft./sec. or 7 cm/s.

4. Power Supply and Power Measurement

A LAMBDA (60 volt, 10 amp) regulated power supply (Model LK 3454 FM), Figure 2.7, was utilized to supply power to the heaters.

A switch board was constructed to distribute power to the individual heaters or combinations of heaters, whichever was required. A Hewlett Packard digital multimeter (3466 A) was utilized to measure voltage and a Westinghouse ammeter measured current, Figure 2.7. The total power was computed as the product of the measured current and voltage drop. For the test, the power supply was set manually to obtain the desired heater voltage.

E. DATA REDUCTION

The primary data-reduction program "JITTER", was written to facilitate taking inputs from manual readings and reducing them to usable parameters for analysis. The program required input concerning Audodata Nine readout, atmospheric pressure, voltage, current input to the heaters, micromanometer reading and test plate setting. The program automatically calibrated thermocouples and calculated Reynolds and Nusselt numbers, convective heat transfer coefficients and freestream velocities. (Appendix B)

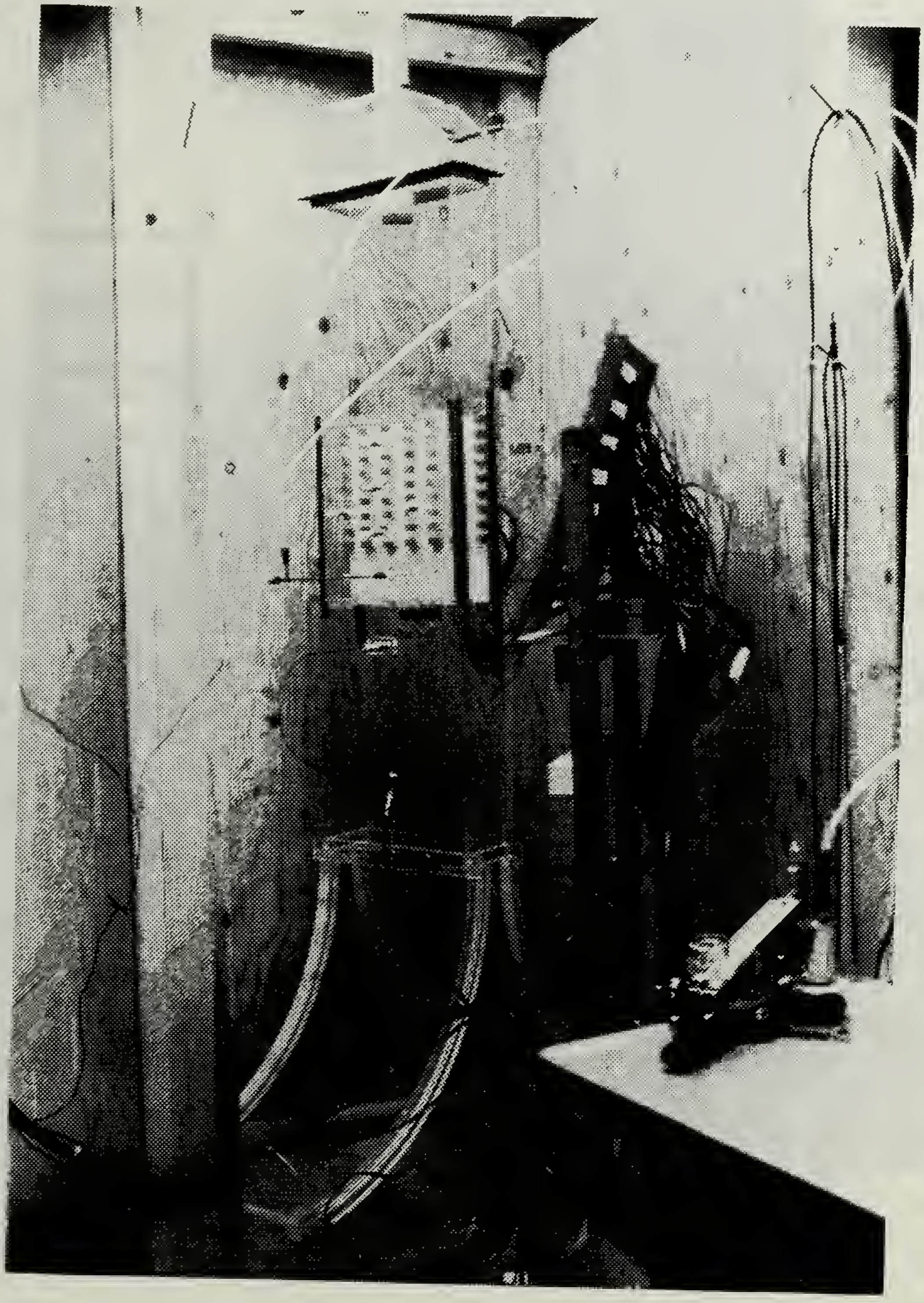

Figure 2.1 Photograph of Wind Tunnel System..

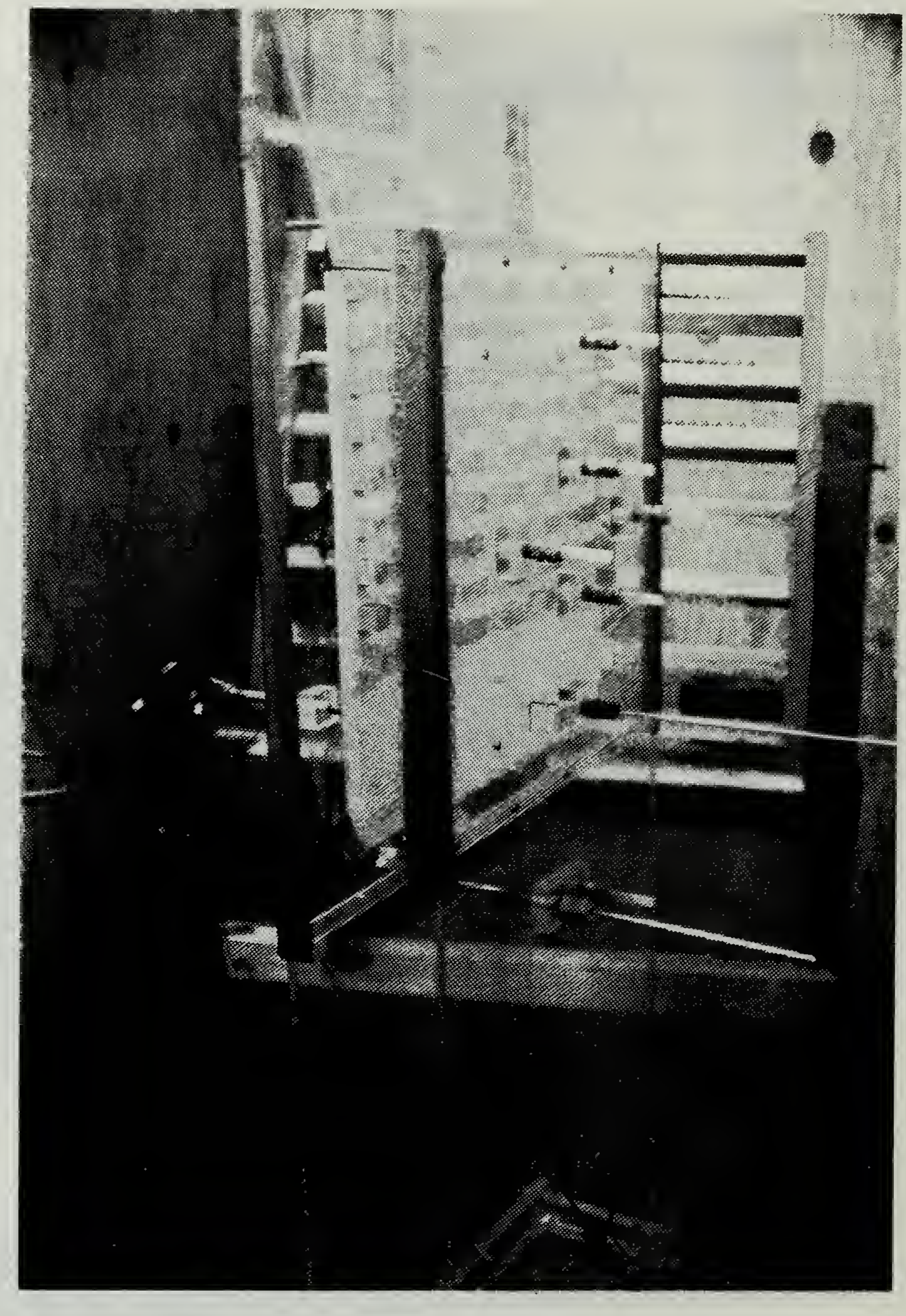

Figure 2.2 Wind Tunnel Test Section.

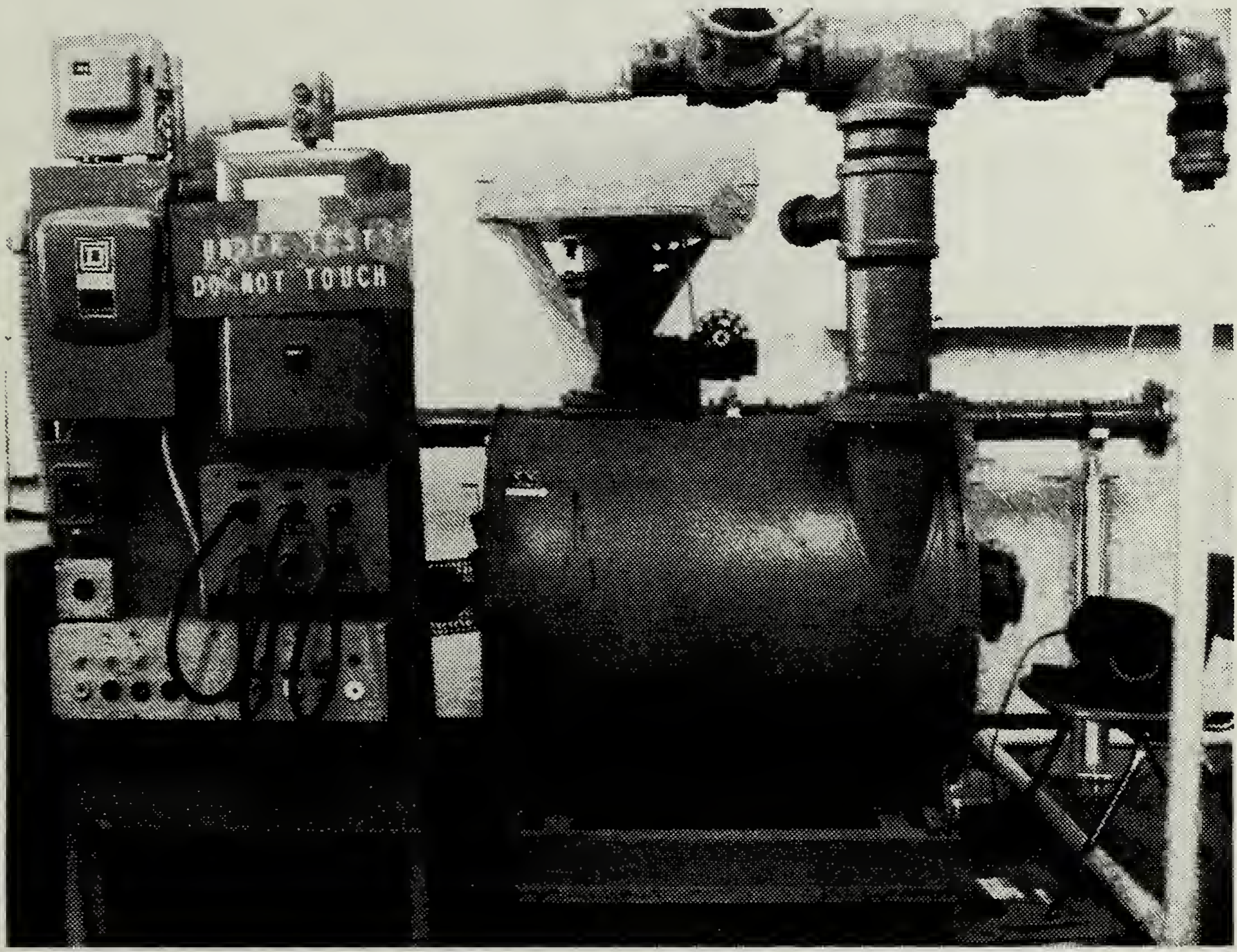

Figure 2.3 Photograph of the Wind Tunnel Air Compressor.

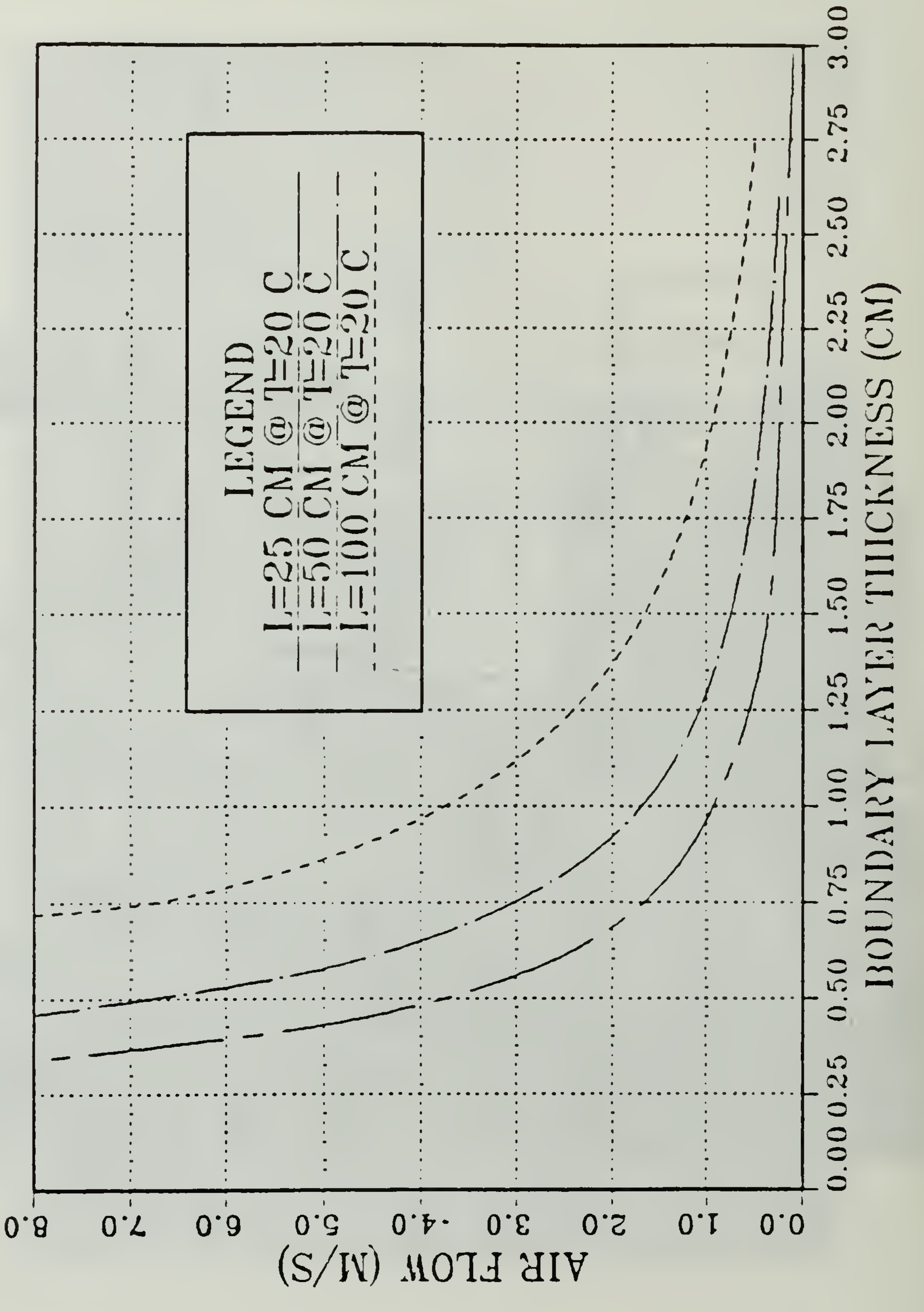

Figure 2.4 Approach Velocity vs. Boundary Layer Thickness for Various Channel Lengths.

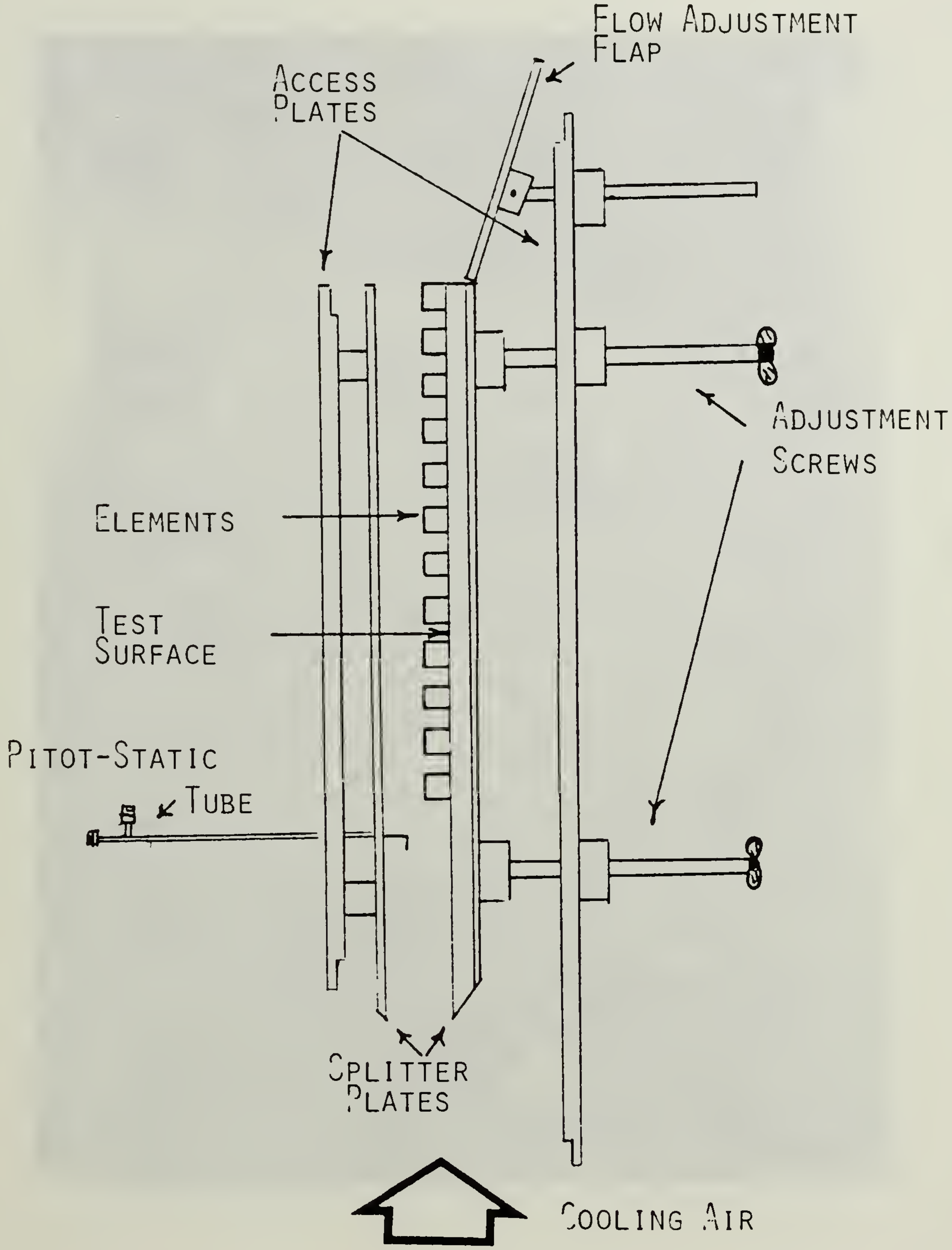

Figure 2.5 Sketch of Test Surface Configuration.

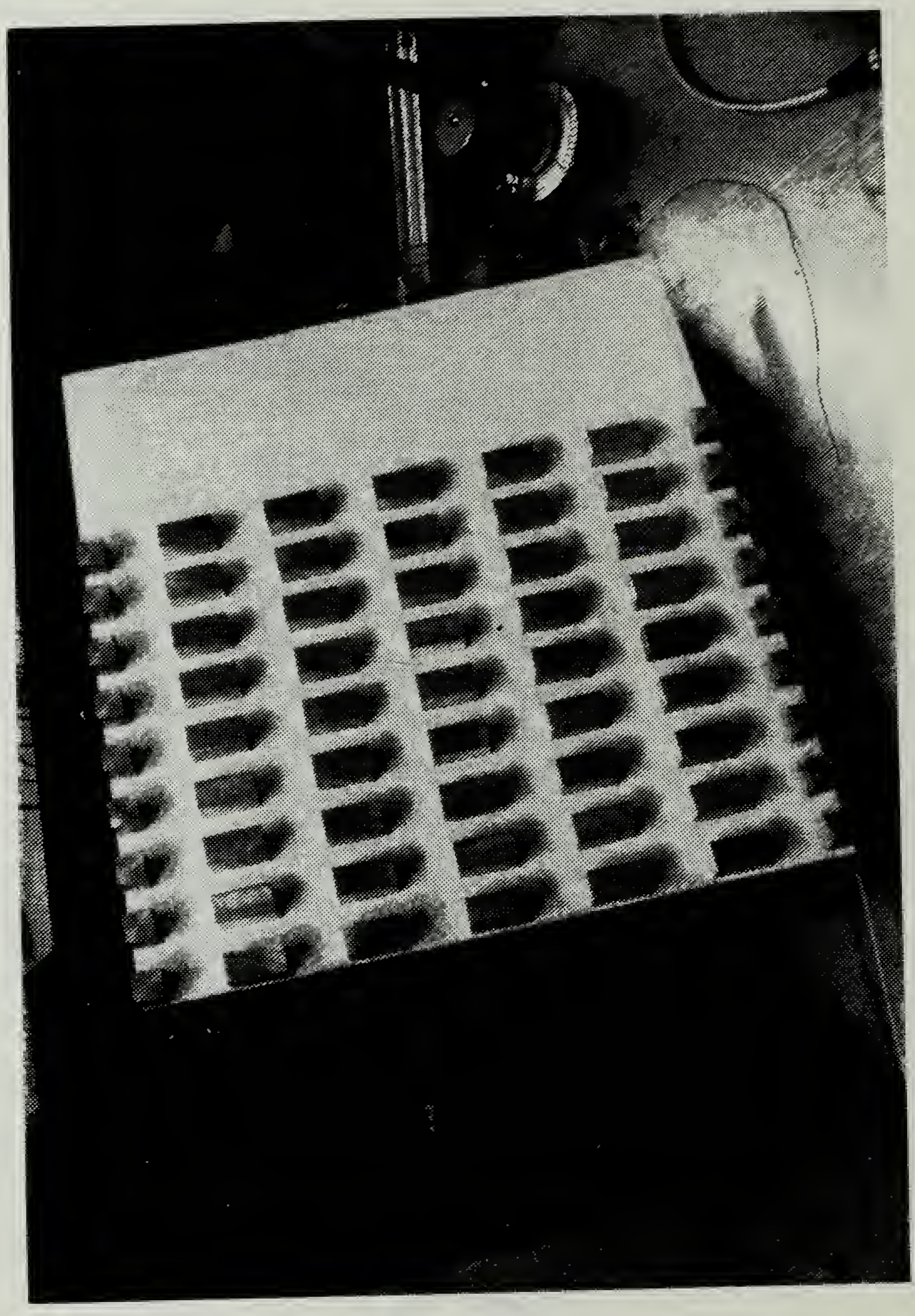

Figure 2.6 Photograph of the Test Plate used in the Experiment.

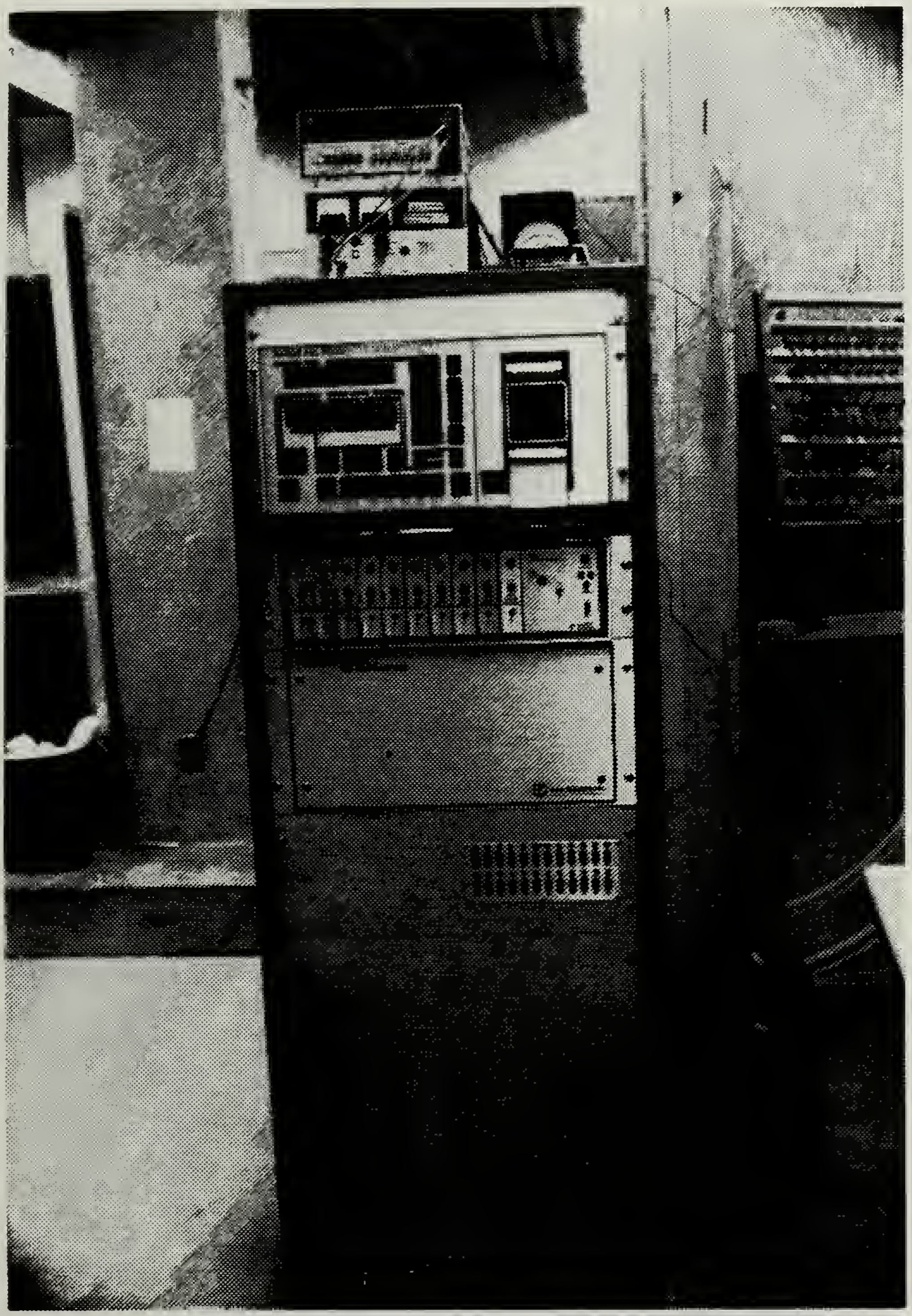

Figure 2.7 Photograph of the Auto-Data Nine.

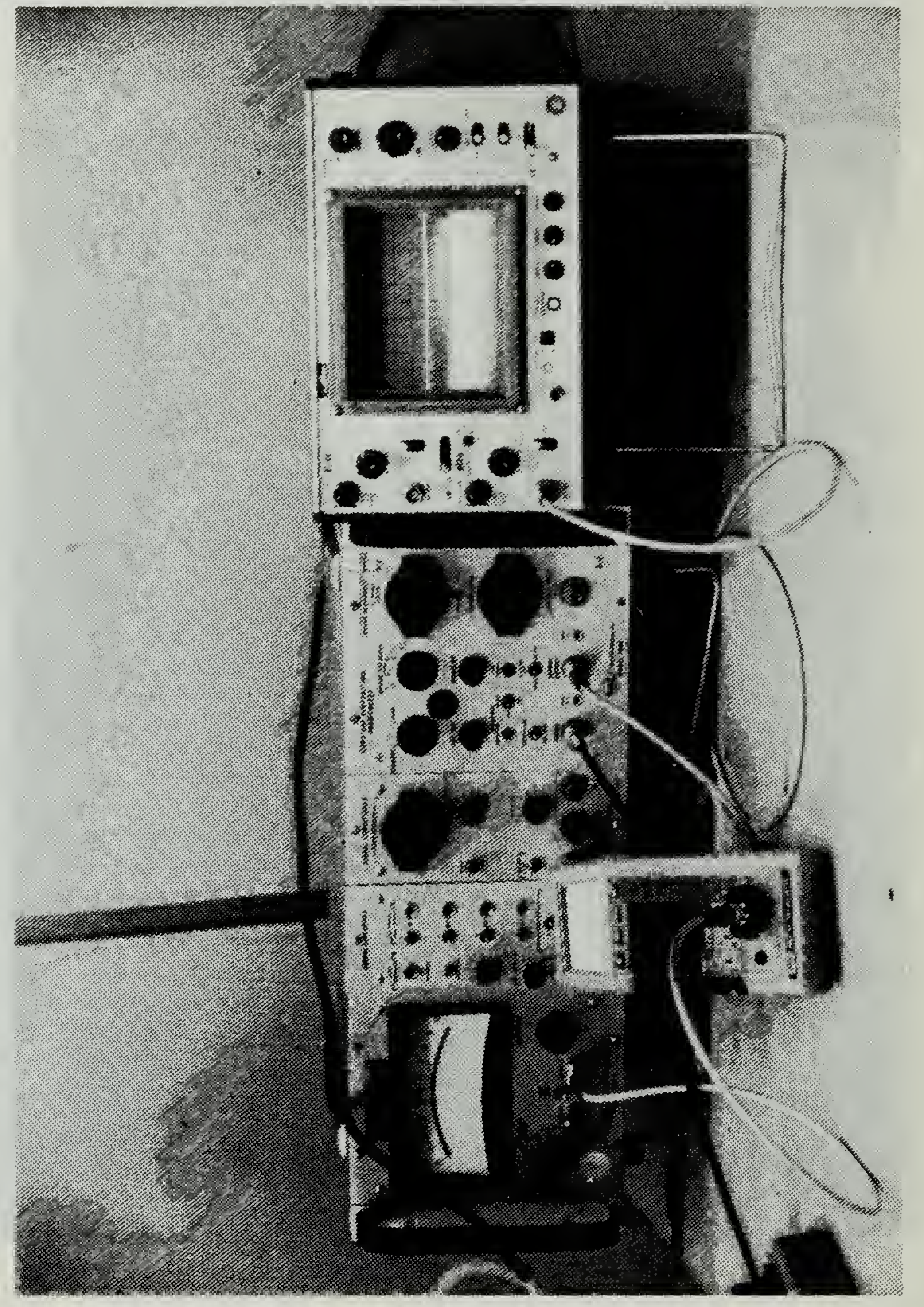

Figure 2.8 Photograph of the Hotwire Instrumentation.

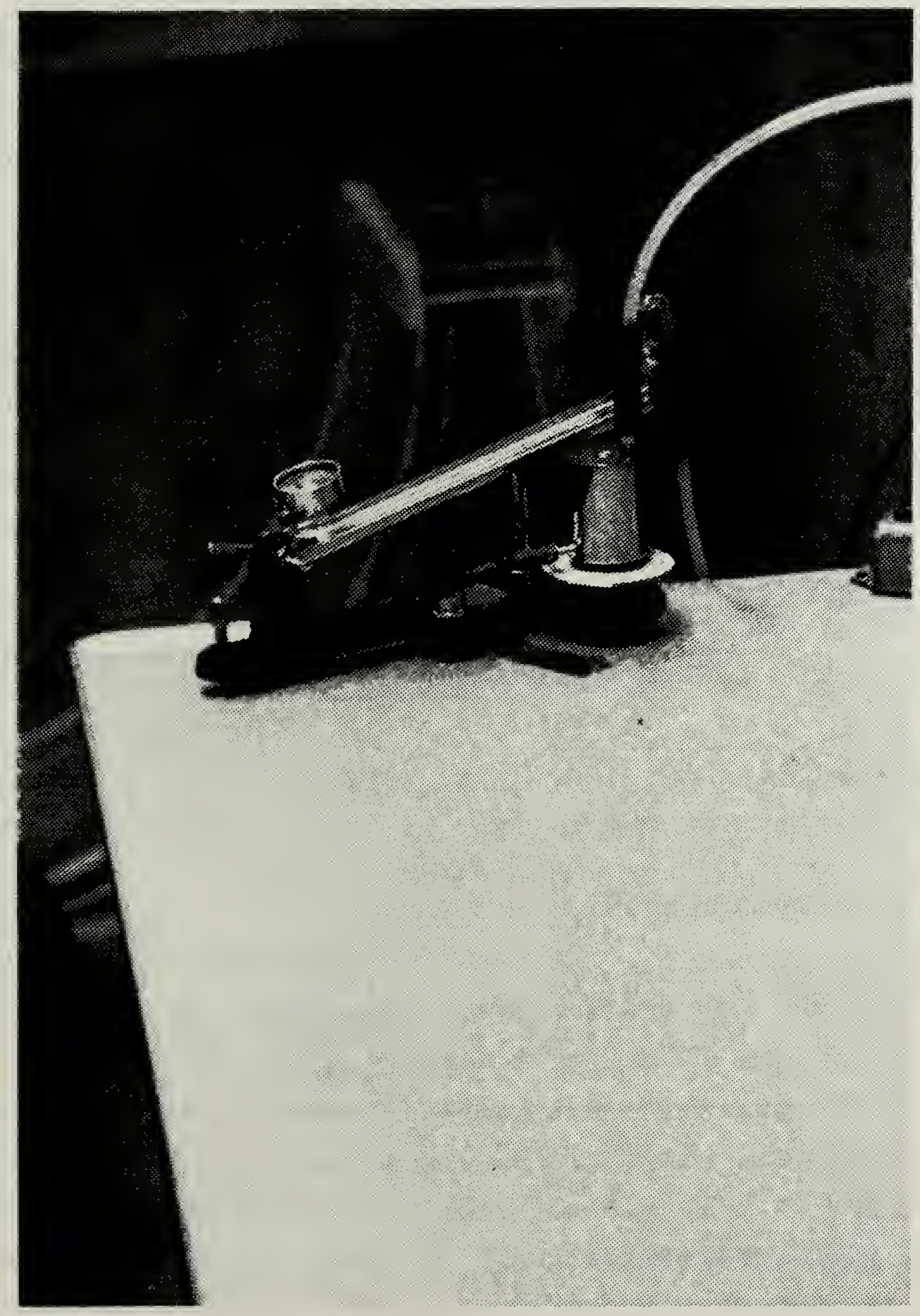

Figure 2.9 Photograph of the Micro-manometer.

III. EXPERIMENTAL RESULTS

A. INTRODUTION

As discussed in Chapter one, the heat transfer behavior is a function of spacing, channel height and flow velocity. The measurements may be considered as divided into two categories:

1. Heat Transfer Coefficient
2. Thermal Wake Function

Table 1 summarizes all parameters. All data is included in Appendix B. Table 2 is provided for the understanding of the graphical curves found in the legends.

TABLE 1

RANGE OF EXPERIMENTAL PARAMETERS TESTED

		Thermal Wake	
H/B	1.0	2.3	4.6
Data Row No.	1-6	1-6	1-6
u_{ref} m/s	1.5, 3.0, 4.5	1.5, 3.0, 4.5	1.5, 3.0, 4.5
		Heat Transfer Coefficient	
H/B	1.0	2.3	4.6
H. B. Row No.	1-6	1-6	1-6
u_{ref} m/s	1.5, 3.0, 4.5	1.5, 3.0, 4.5	1.5, 3.0, 4.5

B. THE RESEARCH ITSELF

The test surface was initially positioned with the top of the cubes touching the opposing wall. The free-stream air velocity was allowed to stabilize at the required velocity and the individual cubes where heated and allowed to warm-up for approximately 90 minutes. Temperature readings for the entire array were taken and the initial cube heater was turned off and another cube heater was allowed to heat and

TABLE 2
LEGEND SYMBOLS

Hx.xRxVx.x	
Hx.x	Channel Height/Cylinder Height Ratio x.x
Rx	Row That the Heated Cylinder is in x
Vx.x	Approach Velocity x.x

stabilize. All temperature readings and air flow velocities were taken at the selected channel height. The channel height was adjusted and the data acquisition was repeated. Through this adjustment, of channel height and flow velocities, all cube temperatures were measured.

C. HEAT TRANSFER COEFFICIENT

The heat transfer coefficient in this study is given by

$$h = \frac{q/A}{T_e - T_{ref}} \qquad \text{(eqn 3.1)}$$

The power input to the element is q and A is the total area of the block exposed to the air (five sides if $H/B > 1$; four sides if $H/B = 1$).

In Figure 3.1, the average heat-transfer-coefficient data, h, for single blocks heated in the first row of an array were plotted against H/B ratio, for three different velocities. At $H/B = 1.0$ (channel height = block height) the value of h is highest for any given approach velocity. The blockage ratio was largest in this geometry and the rectangular cubes are exposed to the highest "local" velocities for a given approach velocity. As H/B is increased, h drops off. The flow appears to take the path of least resistance: over the array instead of through it.

Figure 3.2 shows h for a block heated in the sixth row of the array, plotted against H/B for the same conditions as Figure 3.1. The trends in Figure 3.2 are the same, but here, in the interior of the array, the effects are more pronounced. At $H/B = 1.0$, h in row six is predominantly higher than the values in row one, while for $H/B = 4.6$, h in row six is predominantly lower than in row one.

Figure 3.3 is a cross-plot of h vs. position for H/B = 1.0, parametric on velocity. The value of h for velocities of 3.0 and 4.5 m/s increase with distance into the array and at 1.5 m/s h stays fairly constant. The increase in h can be attributed to the increased turbulence level with downstream distance.

Figure 3.4 is also a crossplot of h vs. position in the array, for H/B = 4.6, parametric on velocity. For this channel height, the value of h decreases with distance into the array for velocities of 3.0 and 4.5 m/s. At the velocity of 1.5 m/s the h stays fairly constant. The behaviors can be attributed to the velocities at 3.0 and 4.5 where there was a reduction in the local mass flow rate below the crests of the elements. There was a slight increase in h during the first two rows before it began to decrease.

The mass flow rate below the crests of the elements and the level of turbulent kinetic energy per unit mass of flow were the influencing factors on the heat transfer. This behavior is shown in Figures 3.1 - 3.4.

Figures 3.5 and 3.6 present the heat transfer data in terms of Nusselt number × H/B vs. Reynolds numbers for two different locations within the array (rows 1 and 6).

D. THERMAL WAKE PROFILE

The thermal wake behind a single block in an array was influenced by the H/B ratio, position in the array and the mass flow rate. Present methods for calculating the distribution of temperature in the array uses the superposition of the wake functions of individual heated blocks. The θ dimensionless temperature parameter is used to analyse the thermal wake.

$$\theta = \frac{T_{measured} - T_{amb}}{T_{hb} - T_{amb}} \qquad \text{(eqn 3.2)}$$

Figures 3.7 - 3.9 relate the temperatures of the blocks downstream of the heated block, in the same streamwise column, to the value of $\theta(R1)$. The data was plotted as measured dimensionless temperature θ, normalized on $\theta(R1)$ vs. the row number downstream of the heated block. A simple 1/N type dependence was observed. Arvizu [Ref. 7: p. 53], found that, with cubes, this relation is 1/N vice a 1/x relationship. He also relates this behavior to the dispersion behavior ofthe pollution behind a single source. The concentrations decayed with distance to the 0.6 and 0.7 power.

E. INTERPRETATION OF RESULTS

In general, it has been shown that:

$$Nu = C_1 Pr^m Re^n \qquad \text{(eqn 3.3)}$$

Because Pr for this experiment can be considered a constant, it is combined with C_1 and the equation becomes $Nu = C_1 Re^n$. The definition of Reynolds number uses the characteristic velocity related to the array velocity. In this experiment, n, the exponent value, varies between .55 to .60. Arvizu [Ref. 7: p. 82], found that the coefficient n is directly related this to the array density, with n equal to .8 for a smooth wall and n equal to .5 for cubical arrays with a S/B equal to 1.5.

1. The Array Velocity

Recall Figure 3.4, which shows that the value of the convective heat transfer coefficient, h, decreases in the flow direction for $H/B > 1.0$. The value of h is a direct reflection of the local air flow around the cube. This suggested that the flow immediately around the cube was decreasing, even though the total flow was constant. Arvizu states [Ref. 7: pp. 85-86], that for cubical arrays, the local flow within the array is the same whenever that axial pressure drop is the same. He also found that there would be the same flow within the array whenever there was the same pressure gradient, regardless of the value of H/B. This assumes that the roughness elements are responsible for most of the pressure drop in the channel: i.e., that the wall shear and bottom wall shear are neglible.

It is possible from the above paragraph to assume that the array velocity and block height are to be used to form the Nusselt number and H/B can be removed as a parameter for this study.

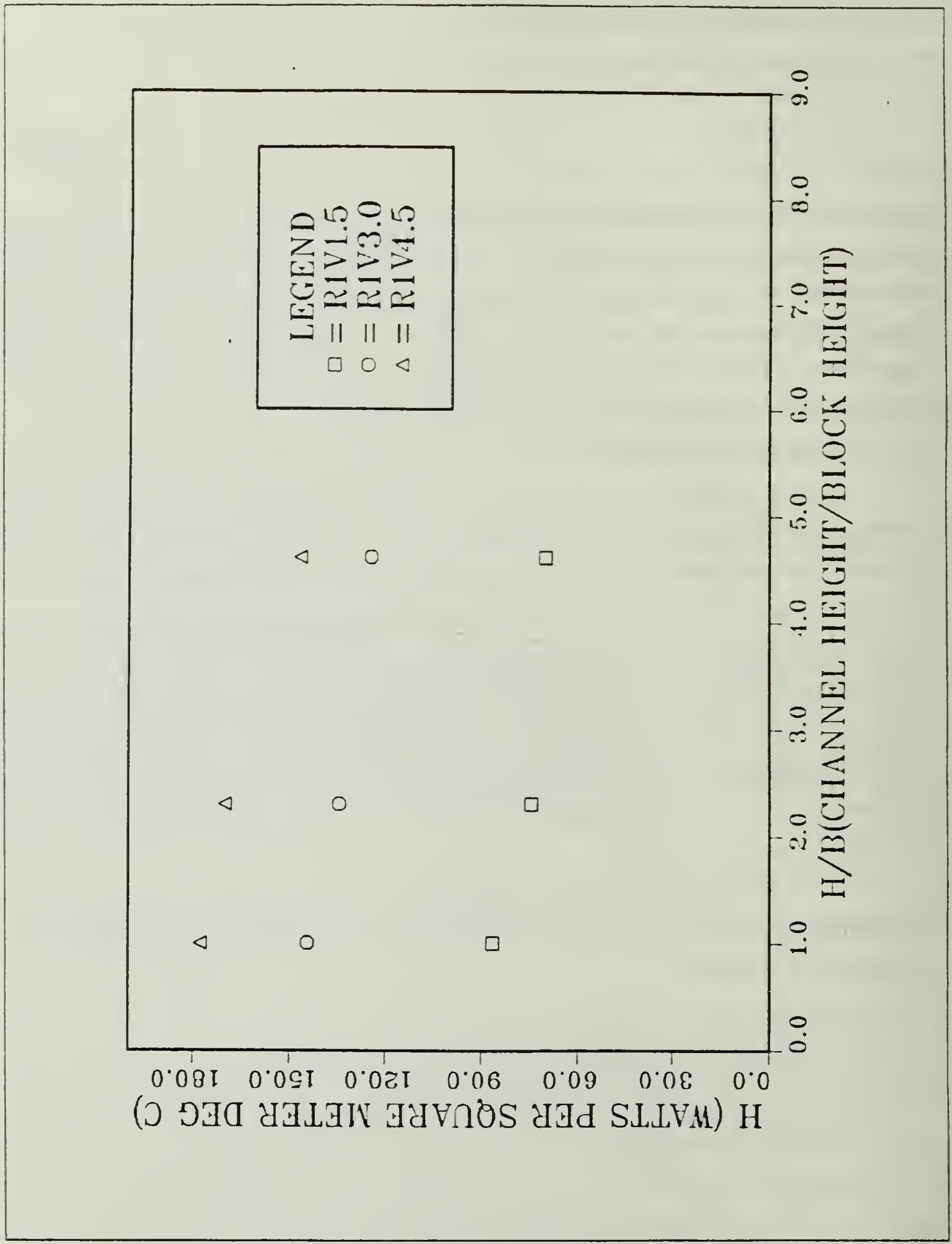

Figure 3.1 Heat Transfer Coefficient vs. channel height ratio for a heated element in the first row..

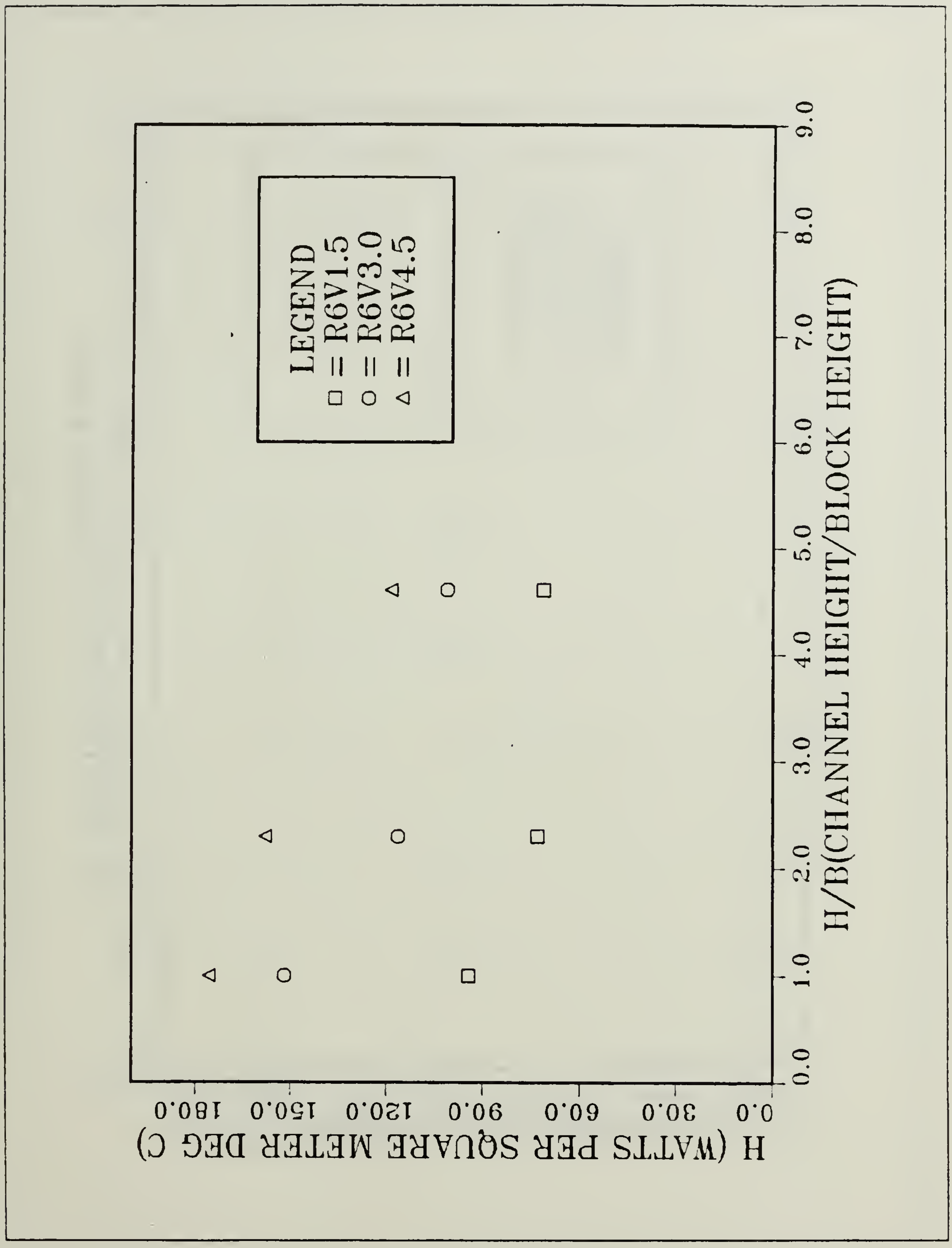

Figure 3.2 Heat Transfer Coefficient vs. Channel Height ratio for a heated element in the sixth row..

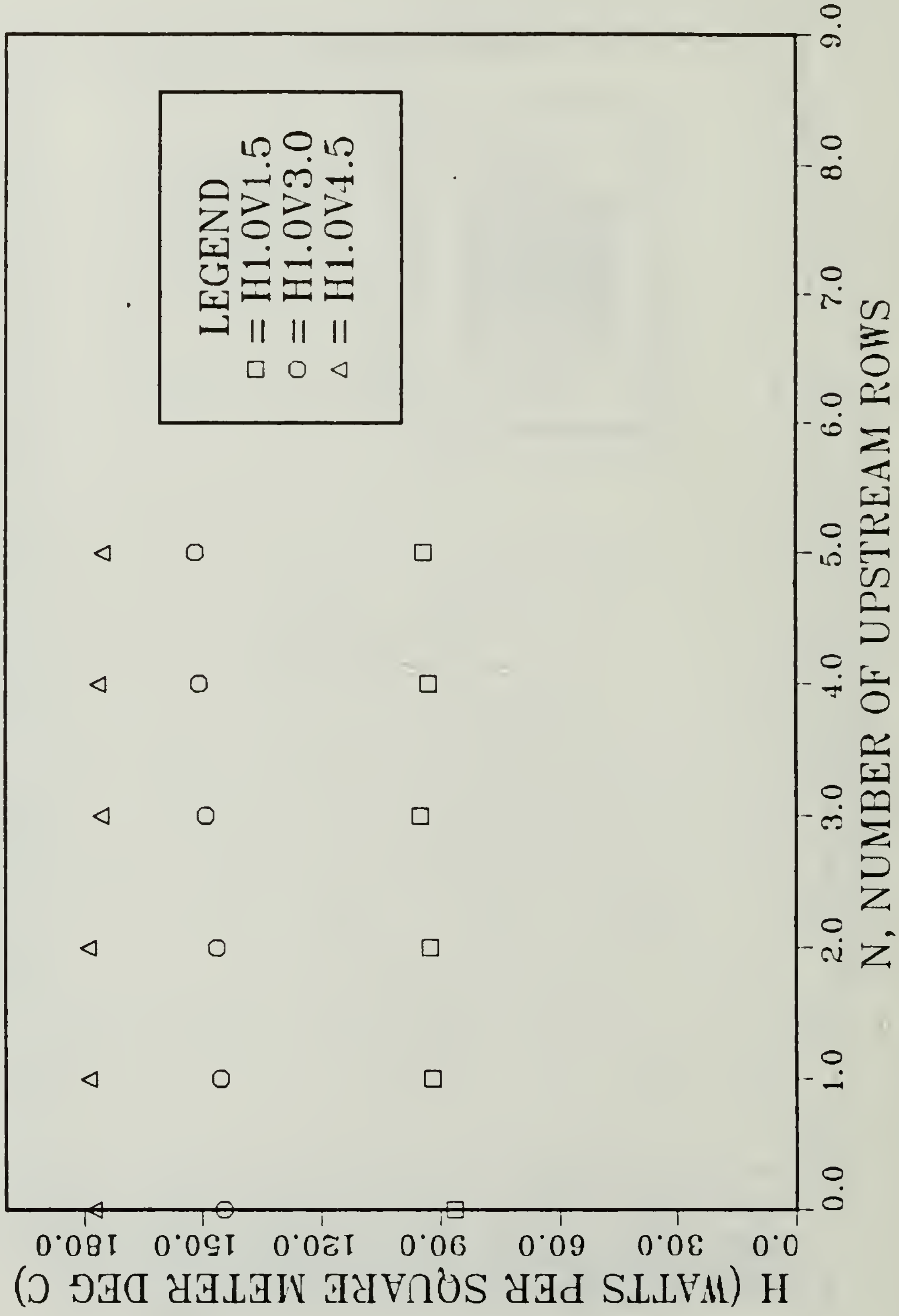

Figure 3.3 Heat Transfer coefficient vs. row position for H/B = 1.0.

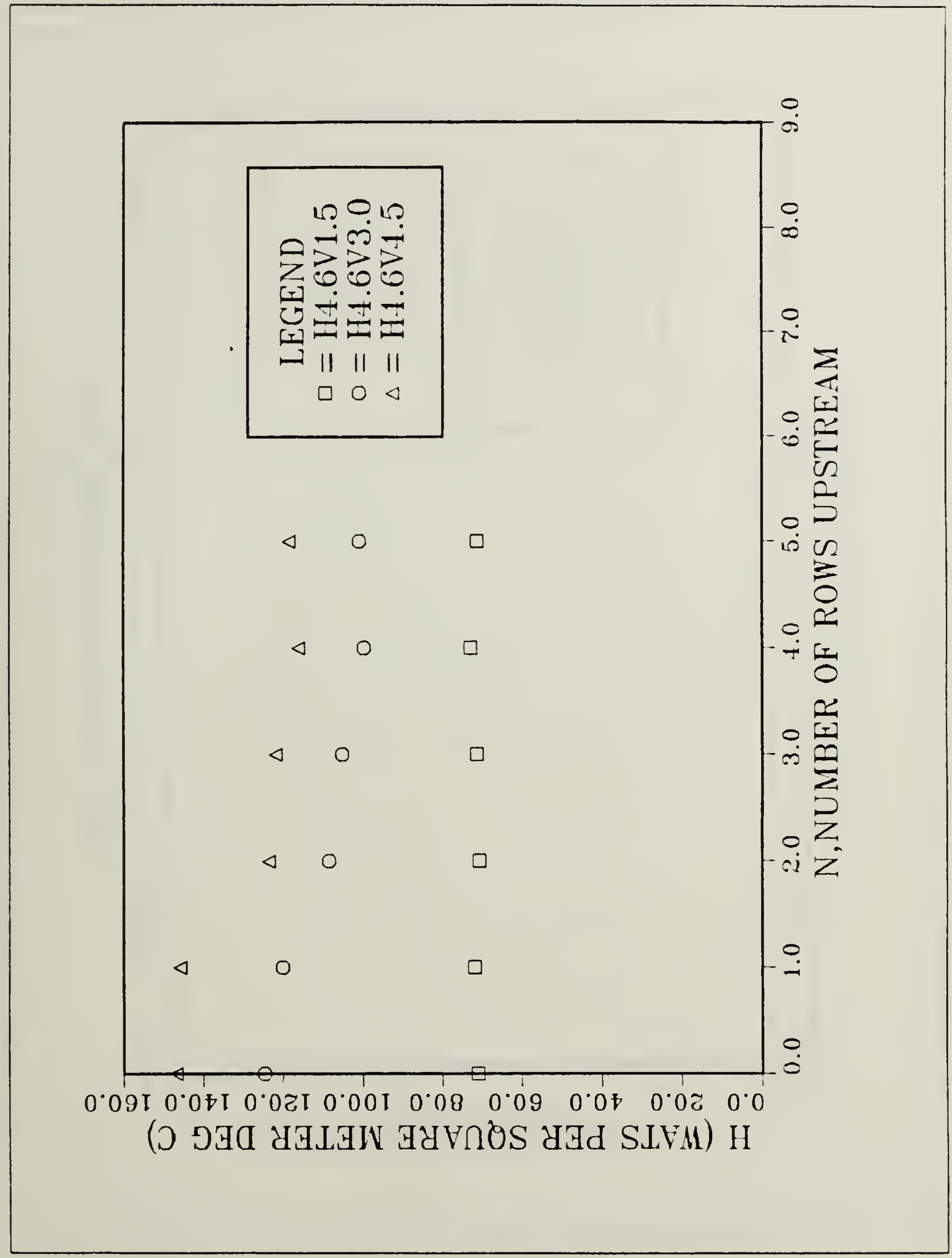

Figure 3.4 HeatTransfer coefficient vs. row position for H/B = 4.6.

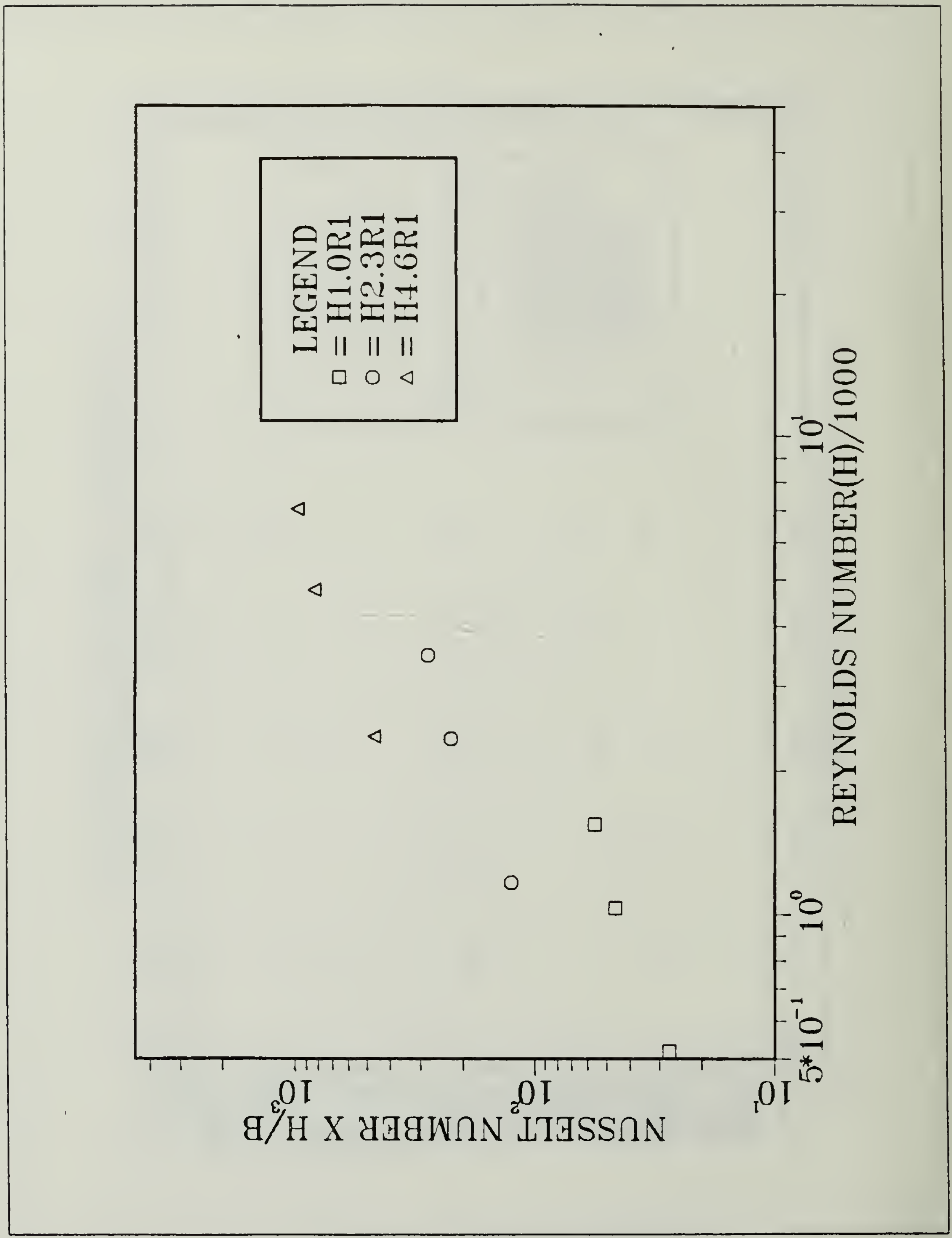

Figure 3.5 Modified Nusselt number vs. duct Reynolds number for heated element in the first row.

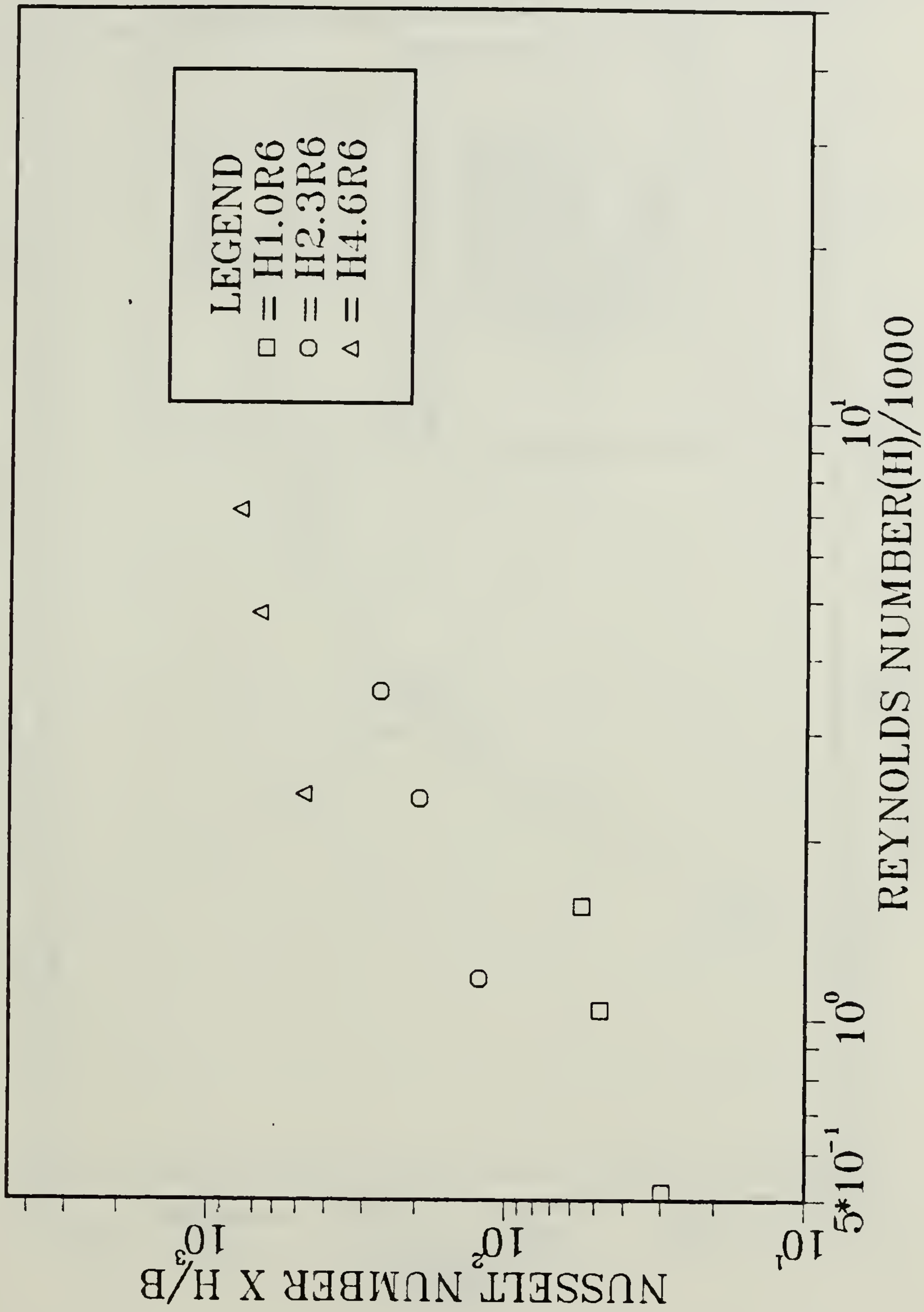

Figure 3.6 Modified Nusselt number vs. duct Reynolds number for heated element in an interior array position.

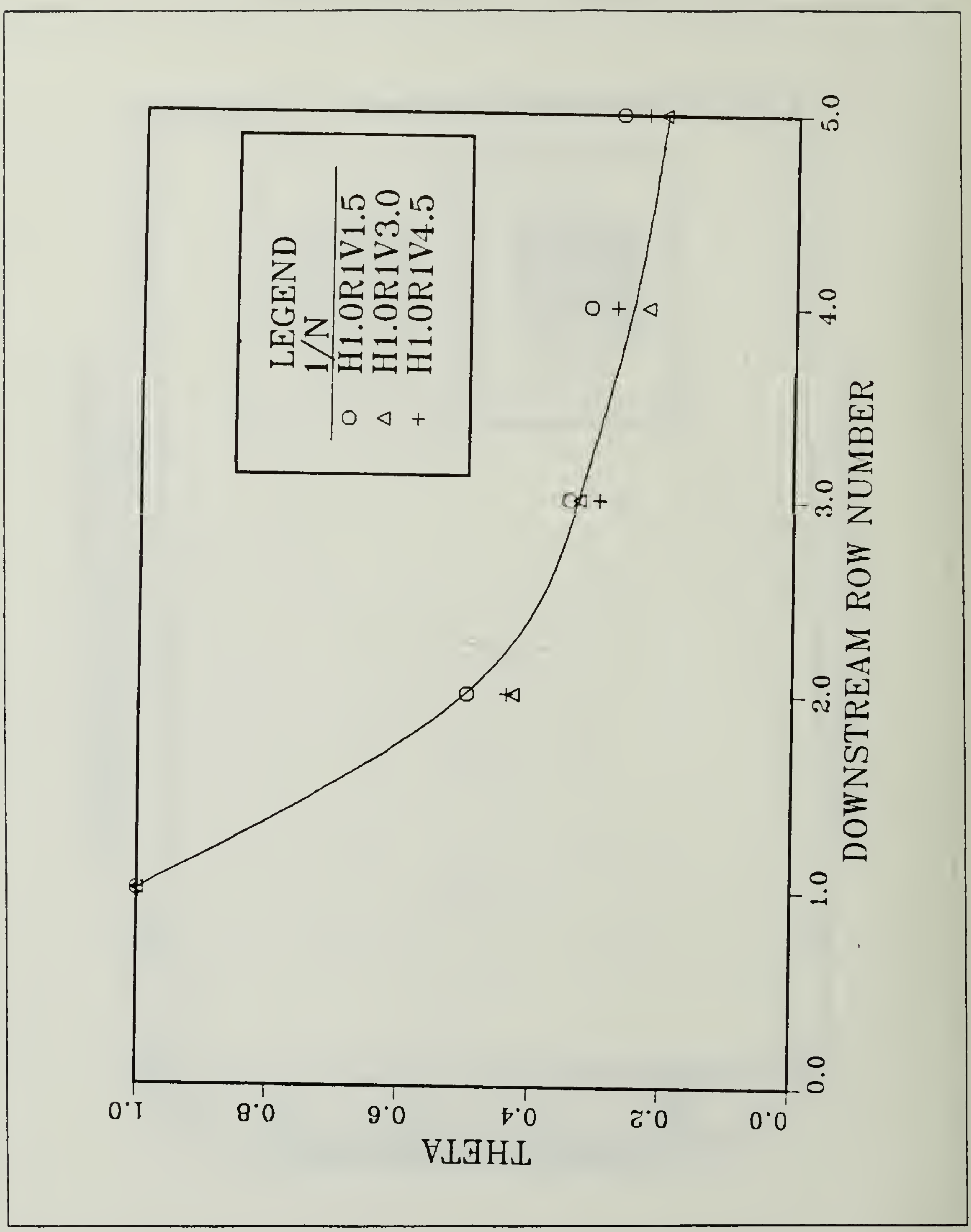

Figure 3.7 Normalized Dimensionless Temperature vs. Row Position for a Channel height Cylinder height ratio of 1.0 with the heated element in the first row..

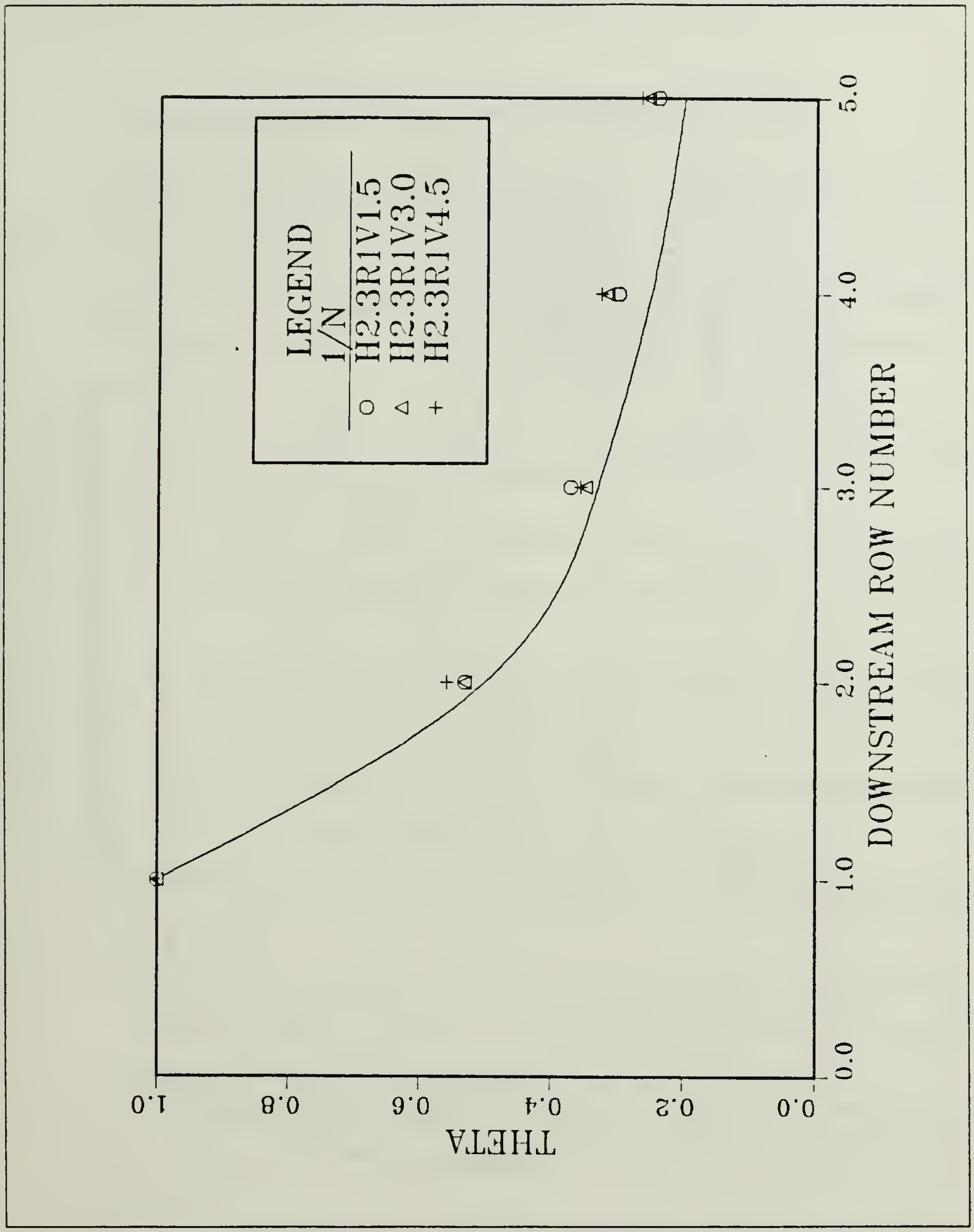

Figure 3.8. Normalized Dimensionless Temperature vs. Row Position for a Channel height/Cylinder height ratio of 2.3 with the heated element in the first row..

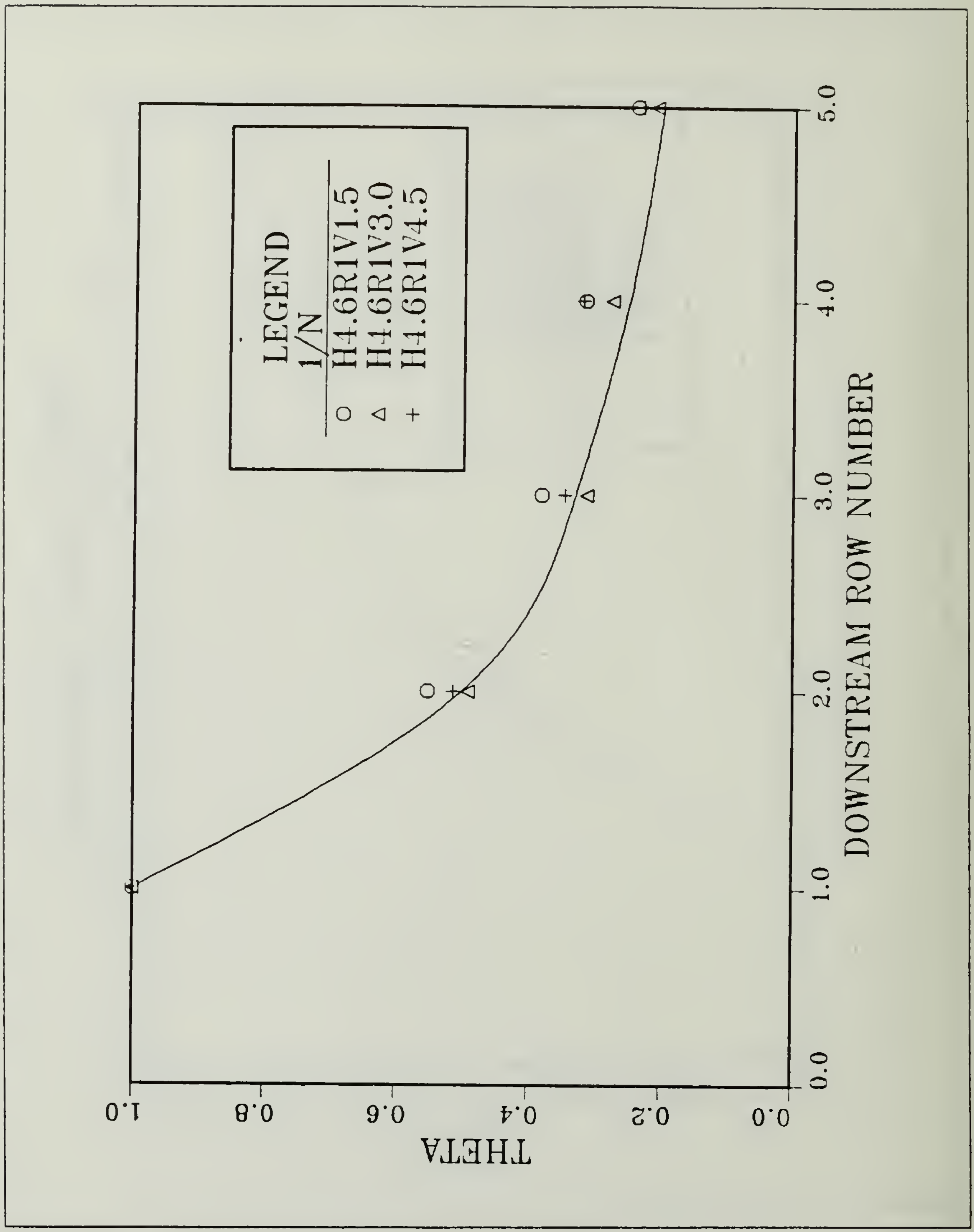

Figure 3.9 Normalized dimensionless Temperature vs. Row Position for a Channel height/Cylinder height ratio of 4.6 with the heated element in the first row..

IV. CONCLUSIONS AND RECOMMENDATIONS

The results and conclusions of this research are for rectangular heated elements on an adiabatic channel wall. They can be summarized as follows:

1. The temperatures of each element in a column of a regular array on an adiabatic wall can be predicted by use of the 1/N characteristic curve produced by the thermal wake of a heated element for a range of channel spacings and mass flow rates.
2. The influence of channel spacings and air-flow rates can be neglected as a controlling parameter for the characteristic curve produced by the thermal wake of a heated element in the array.
3. The heat transfer in the array is primarily influenced by the flow rate of air below the crests of the elements and less by the turbulent kinetic energy in that flow.
4. The convective heat transfer coefficient, h, over the range of channel spacings and mass flow rates tested shows a definite dependence on the form $Nu = C_1 Re^{n}$, where $n = 0.55$.
5. There is an asymptotic limit that the convective heat transfer coefficient approaches as the channel height increases.

For continued work in this field, the following are recommended:

1. Use hot wire anemometry to determine, within the array, wake distributions and velocity profiles.
2. Include a pressure measurement system over the axial length of the test section to determine pressure drops for calculation and correlation of pressure coefficients to the convective heat transfer.
3. Develop a larger test area, expand the number of columns and rows available in order to observe the sideways thermal wakes with minimal interferance from the side walls.
4. Manufacture additional test plates to investigate the effects of array density on the convective heat transfer problem.
5. Use Arvizu's program "COOLIT" [Ref. 7: pp. 135-141], and compare the results of this research to the empirical results that the program would produce.

APPENDIX A

CALIBRATION OF THE AUTO-DATA NINE

```
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C PROGRAM FOR THE CALIBRATION OF THE THERMOCOUPLES  WRITTEN BY         C
C     D.W. MEARS      RESULTS TA=M*TM+B                                C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
       IMPLICIT REAL (A-H,O-Z)
       DIMENSION TA(11),TM(11)
       OPEN(8,FILE='CALIB.DAT')
       OPEN(7,FILE='CALIB.RES')
       M=7
       N=58
       Y=0
       TA(1)=224.18
       TA(2)=175.25
       TA(3)=251.03
       TA(4)=173.53
       TA(5)=137.42
       TA(6)=97.41
       TA(7)=71.04
       DO 10 I=1,M
       Y=Y+TA(I)
   10 CONTINUE
       DO 60 I=1,N
       B=0
       A=0
       X=0
       READ(8,*)TM(1),TM(2),TM(3),TM(4),TM(5),TM(6),TM(7)
       DO 20 J=1,M
       X=X+TM(J)
   20 CONTINUE
       XS=0
       DO 30 J=1,M
       XS=XS+TA(J)*TM(J)
   30 CONTINUE
       A=XS*FLOAT(M)
       DO 40 J=1,M
       B=B+TM(J)*TM(J)
   40 CONTINUE
       B=B*FLOAT(M)
       C=((X*Y)-A)/((X*X)-B)
       G=(1/FLOAT(M))*(Y-C*X)
       WRITE(7,50)I,C,G
   50 FORMAT(2X,'THERMOCOUPLE',I3,5X,'M=',F14.7,5X,'B=',F14.7)
   60 CONTINUE
       END
```

```
  THERMOCOUPLE  1     M=     1.0058441     B=    -1.1933241
  THERMOCOUPLE  2     M=     1.0016870     B=    -0.5642438
  THERMOCOUPLE  3     M=     1.0016470     B=    -0.5864257
  THERMOCOUPLE  4     M=     1.0032187     B=    -0.8692452
  THERMOCOUPLE  5     M=     1.0041752     B=    -0.7800641
  THERMOCOUPLE  6     M=     1.0016069     B=    -0.4797711
  THERMOCOUPLE  7     M=     1.0068874     B=    -1.0167751
  THERMOCOUPLE  8     M=     1.0082874     B=    -1.3434353
  THERMOCOUPLE  9     M=     1.0033331     B=    -0.3716866
  THERMOCOUPLE 10     M=     1.0026093     B=    -1.4008780
  THERMOCOUPLE 11     M=     1.0039444     B=    -1.5746365
  THERMOCOUPLE 12     M=     1.0022478     B=    -1.1846743
  THERMOCOUPLE 13     M=     1.0077648     B=    -2.2380714
  THERMOCOUPLE 14     M=     1.0029936     B=    -1.1193838
  THERMOCOUPLE 15     M=     1.0027590     B=    -1.1243372
```

```
THERMOCOUPLE 16      M=      1.0031261      B=     -1.1981716
THERMOCOUPLE 17      M=      1.0021448      B=     -0.7098911
THERMOCOUPLE 18      M=      1.0052872      B=     -1.2181568
THERMOCOUPLE 19      M=      1.0256109      B=     -4.9308729
THERMOCOUPLE 20      M=      1.0178928      B=     -4.4353018
THERMOCOUPLE 21      M=      1.0171432      B=     -4.5746365
THERMOCOUPLE 22      M=      1.0136099      B=     -4.0994339
THERMOCOUPLE 23      M=      1.0167179      B=     -4.4907570
THERMOCOUPLE 24      M=      1.0167246      B=     -4.5790310
THERMOCOUPLE 25      M=      1.0123777      B=     -3.9271755
THERMOCOUPLE 26      M=      1.0121641      B=     -3.7766800
THERMOCOUPLE 27      M=      1.0101500      B=     -3.4335232
THERMOCOUPLE 28      M=      1.0116796      B=     -3.8131971
THERMOCOUPLE 29      M=      1.0055132      B=     -1.2403736
THERMOCOUPLE 30      M=      1.0005398      B=     -0.0643136
THERMOCOUPLE 31      M=      1.0032072      B=     -0.6667480
THERMOCOUPLE 32      M=      0.9998126      B=      0.0388184
THERMOCOUPLE 33      M=      1.0024481      B=     -0.6872907
THERMOCOUPLE 34      M=      1.0025978      B=     -0.8118024
THERMOCOUPLE 35      M=      1.0013151      B=      0.0251465
THERMOCOUPLE 36      M=      1.0037594      B=     -0.9280482
THERMOCOUPLE 37      M=      1.0049391      B=     -1.0613489
THERMOCOUPLE 38      M=      1.0051708      B=     -1.6157923
THERMOCOUPLE 39      M=      1.0021906      B=     -0.6456822
THERMOCOUPLE 40      M=      1.0026150      B=     -1.2585440
THERMOCOUPLE 41      M=      1.0012007      B=     -0.5714285
THERMOCOUPLE 42      M=      1.0197983      B=     10.8571415
THERMOCOUPLE 43      M=      1.0007734      B=     -0.5309012
THERMOCOUPLE 44      M=      1.0036097      B=     -1.2622766
THERMOCOUPLE 45      M=      1.0048122      B=     -0.9260951
THERMOCOUPLE 46      M=      1.0015764      B=      1.1849537
THERMOCOUPLE 47      M=      1.0073318      B=     -1.4914198
THERMOCOUPLE 48      M=      1.0028048      B=     -0.8452497
THERMOCOUPLE 49      M=      1.0031147      B=     -0.6231514
THERMOCOUPLE 50      M=      1.0086575      B=     -1.7490225
THERMOCOUPLE 51      M=      1.0019674      B=     -0.5809500
THERMOCOUPLE 52      M=      1.0040884      B=     -1.2538013
THERMOCOUPLE 53      M=      1.0013723      B=     -0.5133928
THERMOCOUPLE 54      M=      1.0043945      B=     -1.2029505
THERMOCOUPLE 55      M=      0.9999830      B=     -0.2315499
THERMOCOUPLE 56      M=      1.0062981      B=     -1.7986183
THERMOCOUPLE 57      M=      1.0061407      B=     -1.3419361
THERMOCOUPLE 58      M=      1.0090332      B=     -0.7863420
```

APPENDIX B

DATA REDUCTION PROGRAM AND REDUCED DATA

```
C********************PROGRAM JITTER************************************
C        THIS PROGRAM WRITTEN BY LCDR D. W. MEARS CALCULATES          C
C        THE COOLING CHARACTERISTICS OF A RECTANGULAR CUBED           C
C        FINNED ARRAY WHICH SIMULATES A PRINTED CIRCUIT BOARD         C
C                                                                     C
C            THETA - DIMENSIONLESS TEMPERATURE RATIO                  C
C                                                                     C
C            H - CONVECTIVE HEAT TRANSFER COEFFICIENT                 C
C                                                                     C
C            REH - REYNOLDS NUMBER                                    C
C                                                                     C
C            NUH - NUSSELT NUMBER                                     C
C                                                                     C
C        THE FOLLOWING DATAIS REQUIREDTOBE ENTERED INTO A             C
C        INPUT FILE NAMED HEAT.INP                                    C
C                                                                     C
C            N - ROW IN WHICH THE HEATED CUBE IS IN                   C
C                                                                     C
C            CHANHT - CHANNEL HEIGHT DIVIDED BY THE CUBE HEIGHT       C
C                                                                     C
C            PATM - ATMOSPHERIC IN INCHES OF Hg                       C
C                                                                     C
C            DELP - PITOT STATIC TUBE DELTA P (IN WATER)              C
C                                                                     C
C            VOLTS - VOLTAGE TOTHE HEATED CUBE                        C
C                                                                     C
C            AMPS - CURRENT TO THE HEATED CUBE                        C
C                                                                     C
C            T(I,J) - TEMPERATURES OF THE CUBES IN THE ARRAY          C
C                                                                     C
C            T(K) - AMBIENT TEMPERATURE THERMOCOUPLES                 C
C                                                                     C
C       THE INPUT FILE IS TO BE IN THIS FORMAT                        C
C                                                                     C
C       N   PATM   DELP   VOLT AMP CHANHT                             C
C       T(1.1) ....            T(1,5)                                 C
C          .                                                          C
C          .                                                          C
C          .                                                          C
C                                                                     C
C                                                                     C
C       T(9,1)....             T(9,5)                                 C
C       T(1)...T(3)                                                   C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
       IMPLICIT REAL(A-H,O-Z)
       DIMENSION CAL(9,5,2),CALI(3,2),T(9,5),TINF(3),THETA(10)
       M=9
       N=5
       P=3
       OPEN(1,FILE='HEAT.INP')
       OPEN(2,FILE='CAL.DAT')
       OPEN(3,FILE='HEAT.RES')
       DO 20 I=1,M
       DO 10 J=1,N
       READ(2,*)CAL(I,J,1),CAL(I,J,2)
    10 CONTINUE
    20 CONTINUE
       DO 25 I=1,3
       READ(2,*)CALI(I,1),CALI(I,2)
    25 CONTINUE
       READ(1,*)NU,ATM,DELP,VOLT,AMP,CHANHT
```

```
      DO 30 I=1,M
      READ(1,*)T(I,1),T(I,2),T(I,3),T(I,4),T(I,5)
   30 CONTINUE
      WRITE(3,31)NU
   31 FORMAT(2X,'THE HEATED CUBE IS IN COLUMN 3 AND ROW ',I2)
      WRITE(3,32)ATM
   32 FORMAT(2X,'BAROMETRIC PRESSURE  ',F7.3,' INCHES OF Hg')
      WRITE(3,33)DELP
   33 FORMAT(2X,'PITOT-STATIC TUBE DELTA ',F6.5,' INCHES WATER')
      WRITE(3,34)VOLT,AMP
   34 FORMAT(2X,'VOLTS ',F7.4,5X,'AMPS ',F7.4)
      WRITE(3,35)CHANHT
   35 FORMAT(2X,'CHANNEL HEIGHT RATIO ',F3.1)
      WRITE(3,36)
   36 FORMAT(/,2X,'THE INPUT TEMPERATURE ARRAY IN DEGREES F')
      DO 38 I=1,M
      WRITE(3,37)T(I,1),T(I,2),T(I,3),T(I,4),T(I,5)
   37 FORMAT(2X,F4.1,5X,F4.1,5X,F5.1,5X,F4.1,5X,F4.1)
   38 CONTINUE
      DO 50 I=1,M
      DO 40 J=1,N
      T(I,J)=CAL(I,J,1)*T(I,J)+CAL(I,J,2)
   40 CONTINUE
   50 CONTINUE
      READ(1,*)TINF(1),TINF(2),TINF(3)
      DO 60 I=1,3
      TINF(I)=CALI(I,1)*TINF(I)+CALI(I,2)
   60 CONTINUE
      WRITE(3,62)
   62 FORMAT(/,2X,'CALIBRATED TEMPERATURES IN DEGREES F')
      DO 65 I=1,9
      WRITE(3,63)T(I,1),T(I,2),T(I,3),T(I,4),T(I,5)
   63 FORMAT(2X,F4.1,5X,F4.1,5X,F5.1,5X,F4.1,5X,F4.1)
   65 CONTINUE
      WRITE(3,66)
   66 FORMAT(/,2X,'AMBIENT TEMPERATURE CALIBRATED IN FAHR.')
      WRITE(3,67)TINF(1),TINF(2),TINF(3)
   67 FORMAT(2X,F7.3,3X,F7.3,3X,F7.3)
      TAMB=(TINF(1)+TINF(2)+TINF(3))/3
      K=9-NU
      DO 70 I=1,K
      THETA(I)=(T(NU+I,3)-TAMB)/(T(NU+1,3)-TAMB)
   70 CONTINUE
      DO 90 I=1,M
      DO 80 J=1,N
      T(I,J)=(T(I,J)-32.0)*.55556
   80 CONTINUE
   90 CONTINUE
      TAMB=(TAMB-32.0)*.55556
      RHO=ATM*3386.5/(287*(TAMB+273.0))
      DELPPA=DELP*248.84
      VELMS=SQRT(2.0*DELPPA/RHO)
      VELFS=3.2808*VELMS
      QINPUT=VOLT*AMP
      QLOSS=.62927E-3+.5059E-2*(T(NU,3)-TAMB)-.023695E-5*(T(NU,3)-TAMB)
     .**2
      IF(CHANHT.EQ.1)GO TO 100
      A=1.29E-3
      GO TO 110
  100 CONTINUE
      A=.9677E-3
  110 CONTINUE
      TEMP=T(NU,3)
      H=(QINPUT-QLOS)/(A*(TEMP-TAMB))
      VISK=38.02E-6-109.8E-9*(27.0-TAMB)
      X=CHANHT*.0127
      COND=.0407-76.8E-6*(27.0-TAMB)
      DUH=X*H/COND
      REH=X*VELMS/VISK
      DO 130 I=1,K
      WRITE(3,120)I,THETA(I)
120  FORMAT(2X,'THETA',I1,'=',2X,F14.7)
130  CONTINUE
      WRITE(3,140)H,REH
140  FORMAT(/,2X,'H=',2X,F7.3,' W/m2C',15X,'ReH=',F14.7)
      WRITE(3,150)DUH
150  FORMAT(2X,'NUSSELT#=',F7.3)
      WRITE(3,160)VELMS,VELFS
160  FORMAT(2X,'FREESTREAM VELOCITY =',F7.3,' m/s=',F7.3,' ft/s')
      WRITE(3,170)QINPUT,QLOSS,COND
170  FORMAT(2X,'Qin=',F7.3,' Watts',3X,'Qloss=',F7.3,' Watts',5x,
     .'CONDUCTIVITY=',F7.3,' W/mC')
      WRITE(3,180)TAMB,VISK
180  FORMAT(2X,'TAMB=',F7.3,' C',10X,'VISCOSITY=',F10.8,' m2/s')
      WRITE(3,190)
190  FORMAT(/,2X,'SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE')
      DO 210 I=1,M
      WRITE(3,200)T(I,1),T(I,2),T(I,3),T(I,4),T(I,5)
200  FORMAT(2X,F8.1,5X,F8.1,5X,F10.1,5X,F8.1,5X,F8.1)
210  CONTINUE
      END
```

```
THE HEATED CUBE IS IN COLUMN 3 AND ROW  1
BAROMETRIC PRESSURE   30.286 INCHES OF Hg
PITOT-STATIC TUBE DELTA .00560 INCHES WATER
VOLTS  2.9270     AMPS  1.4000
CHANNEL HEIGHT RATIO 1.0

THE INPUT TEMPERATURE ARRAY IN DEGREES F
65.4      65.4      152.9      65.7      65.5
65.4      65.4       73.1      65.1      65.9
65.8      65.9       69.8      68.8      65.6
65.5      65.5       68.3      69.5      69.2
69.3      69.3       71.6      69.2      69.1
69.1      68.9       71.1      65.3      65.3
65.1      65.3       67.2      65.5      65.2
65.3      65.3       67.0      65.7      65.5
65.6      65.6       66.9      65.9      65.6

CALIBRATED TEMPERATURES IN DEGREES F
63.6      63.6      151.4      63.9      63.8
63.7      63.8       71.6      63.5      63.5
63.4      63.5       67.4      66.6      63.3
63.3      63.4       66.1      63.5      63.3
63.4      63.5       65.9      63.5      63.4
63.5      63.4       65.5      63.4      63.4
63.3      63.4       65.4      63.6      63.4
63.4      63.4       64.9      63.6      63.4
63.4      63.5       64.6      63.7      63.3

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 63.400    63.302    63.200
THETA1=       1.0000000
THETA2=        .4966078
THETA3=        .3439455
THETA4=        .3154521
THETA5=        .2683605
THETA6=        .2571974
THETA7=        .1973163
THETA8=        .1598605

H=   86.495 W/m2C               ReH=    517.0348000
NUSSELT#= 27.488
FREESTREAM VELOCITY =  1.505 m/s=  4.937 ft/s
Qin=  4.098 Watts   Qloss=   .248 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 17.389 C          VISCOSITY= .00003696 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
```

```
     17.6          17.6           66.3          17.7          17.7
     17.6          17.7           22.0          17.5          17.5
     17.4          17.5           19.7          19.2          17.4
     17.4          17.5           19.0          17.5          17.4
     17.5          17.5           18.8          17.5          17.5
     17.5          17.4           18.6          17.5          17.4
     17.4          17.5           18.6          17.5          17.4
     17.5          17.4           18.3          17.6          17.5
     17.4          17.5           18.1          17.6          17.4

THE HEATED CUBE IS IN COLUMN 3 AND ROW  2
BAROMETRIC PRESSURE   30.286 INCHES OF Hg
PITOT-STATIC TUBE DELTA .00560 INCHES WATER
VOLTS  2.9410     AMPS  1.4000
CHANNEL HEIGHT RATIO 1.0

THE INPUT TEMPERATURE ARRAY IN DEGREES F
65.9      65.9       67.4      66.2      65.9
65.7      65.9      148.0      65.5      66.4
66.2      66.4       75.6      66.3      66.0
65.9      66.0       69.9      70.1      69.9
70.0      69.9       72.8      69.8      69.7
69.6      69.5       71.9      65.7      65.7
65.5      65.7       67.9      65.9      65.7
65.8      65.7       67.4      66.1      66.0
66.0      66.0       67.5      66.4      66.1

CALIBRATED TEMPERATURES IN DEGREES F
64.1      64.1       65.6      64.4      64.2
64.0      64.3      147.1      63.9      64.0
63.8      64.0       73.2      64.1      63.7
63.7      63.9       67.8      64.2      64.0
64.1      64.2       67.1      64.1      64.0
64.0      64.0       66.3      63.8      63.8
63.7      63.8       66.1      64.0      63.9
63.9      63.8       65.3      64.0      63.9
63.8      63.9       65.2      64.2      63.8

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 63.801    63.805    63.702
THETA1=       1.0000000
THETA2=        .4200136
THETA3=        .3542062
THETA4=        .2698356
THETA5=        .2485592
THETA6=        .1649532
THETA7=        .1532385

H=   91.925 W/m2C                   ReH=   516.8669000
NUSSELT#= 29.199
FREESTREAM VELOCITY =  1.506 m/s=  4.939 ft/s
Qin=  4.117 Watts   Qloss=   .234 Watts    CONDUCTIVITY=   .040 W/mC
TAMB= 17.650 C          VISCOSITY= .00003699 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     17.8          17.9           18.7          18.0          17.9
     17.8          18.0           63.9          17.7          17.8
     17.7          17.8           22.9          17.8          17.6
     17.6          17.7           19.9          17.9          17.8
     17.8          17.9           19.5          17.8          17.8
     17.8          17.8           19.1          17.7          17.6
     17.6          17.7           19.0          17.8          17.7
     17.7          17.6           18.5          17.8          17.7
     17.7          17.7           18.5          17.9          17.7

THE HEATED CUBE IS IN COLUMN 3 AND ROW  2
BAROMETRIC PRESSURE   30.286 INCHES OF Hg
PITOT-STATIC TUBE DELTA .00560 INCHES WATER
VOLTS  2.9410     AMPS  1.4000
```

```
CHANNEL HEIGHT RATIO 1.0

THE INPUT TEMPERATURE ARRAY IN DEGREES F
65.9      65.9       67.4      66.2      65.9
65.7      65.9      148.0      65.5      66.4
66.2      66.4       75.6      66.3      66.0
65.9      66.0       69.9      70.1      69.9
70.0      69.9       72.8      69.8      69.7
69.6      69.5       71.9      65.7      65.7
65.5      65.7       67.9      65.9      65.7
65.8      65.7       67.4      66.1      66.0
66.0      66.0       67.5      66.4      66.1

CALIBRATED TEMPERATURES IN DEGREES F
64.1      64.1       65.6      64.4      64.2
64.0      64.3      147.1      63.9      64.0
63.8      64.0       73.2      64.1      63.7
63.7      63.9       67.8      64.2      64.0
64.1      64.2       67.1      64.1      64.0
64.0      64.0       66.3      63.8      63.8
63.7      63.8       66.1      64.0      63.9
63.9      63.8       65.3      64.0      63.9
63.8      63.9       65.2      64.2      63.8

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 63.801     63.805    63.702
THETA1=        1.0000000
THETA2=         .4200136
THETA3=         .3542062
THETA4=         .2698356
THETA5=         .2485592
THETA6=         .1649532
THETA7=         .1532385

H=   91.925 W/m2C                       ReH=   516.8669000
NUSSELT#= 29.199
FREESTREAM VELOCITY =  1.506 m/s=  4.939 ft/s
Qin=  4.117 Watts    Qloss=    .234 Watts      CONDUCTIVITY=    .040 W/mC
TAMB= 17.650 C            VISCOSITY= .00003699 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     17.8            17.9            18.7            18.0            17.9
     17.8            18.0            63.9            17.7            17.8
     17.7            17.8            22.9            17.8            17.6
     17.6            17.7            19.9            17.9            17.8
     17.8            17.9            19.5            17.8            17.8
     17.8            17.8            19.1            17.7            17.6
     17.6            17.7            19.0            17.8            17.7
     17.7            17.6            18.5            17.8            17.7
     17.7            17.7            18.5            17.9            17.7

THE HEATED CUBE IS IN COLUMN 3 AND ROW  3
BAROMETRIC PRESSURE   30.286 INCHES OF Hg
PITOT-STATIC TUBE DELTA .00560 INCHES WATER
VOLTS  2.7500      AMPS  1.4000
CHANNEL HEIGHT RATIO 1.0

THE INPUT TEMPERATURE ARRAY IN DEGREES F
65.9      65.9       65.8      66.1      65.9
65.7      65.9       67.3      65.5      66.6
66.4      66.8      143.3      66.5      66.1
66.0      66.2       77.6      70.4      70.0
70.2      70.1       75.3      70.0      69.8
69.7      69.7       73.1      65.9      65.9
65.7      65.9       68.7      66.0      65.9
66.0      65.9       67.9      66.2      66.1
66.2      66.2       67.9      66.5      66.3

CALIBRATED TEMPERATURES IN DEGREES F
```

```
64.1     64.1      64.0     64.3     64.2
64.0     64.3      65.7     63.9     64.2
64.0     64.4     141.5     64.3     63.8
63.8     64.1      75.5     64.5     64.1
64.3     64.4      69.7     64.3     64.1
64.1     64.2      67.5     64.0     64.0
63.9     64.0      66.9     64.1     64.1
64.1     64.0      65.8     64.1     64.0
64.0     64.1      65.6     64.3     64.0

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 64.001    64.007    63.802
THETA1=        1.0000000
THETA2=         .4960722
THETA3=         .3119469
THETA4=         .2586492
THETA5=         .1643351
THETA6=         .1458730

H=   92.358 W/m2C                   ReH=516.807
NUSSELT#= 29.332
FREESTREAM VELOCITY =  1.506 m/s=  4.940 ft/s
Qin=  3.850 Watts     Qloss=   .218 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 17.743 C          VISCOSITY= .00003700 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     17.8          17.9            17.8          18.0          17.9
     17.8          18.0            18.7          17.7          17.9
     17.8          18.0            60.8          17.9          17.6
     17.7          17.9            24.2          18.0          17.8
     18.0          18.0            20.9          17.9          17.9
     17.8          17.9            19.7          17.8          17.8
     17.7          17.8            19.4          17.8          17.8
     17.8          17.8            18.8          17.8          17.8
     17.8          17.8            18.7          17.9          17.8


THE HEATED CUBE IS IN COLUMN 3 AND ROW  4
BAROMETRIC PRESSURE   30.286 INCHES OF Hg
PITOT-STATIC TUBE DELTA .00560 INCHES WATER
VOLTS  2.9470     AMPS  1.4000
CHANNEL HEIGHT RATIO 1.0

THE INPUT TEMPERATURE ARRAY IN DEGREES F
65.9     65.9      65.8     66.0     65.9
65.7     65.8      65.5     65.5     66.6
66.4     66.8      68.7     66.5     66.1
66.0     66.2     146.7     70.4     70.1
70.4     70.1      84.6     70.0     70.0
69.8     69.8      75.8     65.8     65.9
65.7     65.9      70.0     65.9     65.8
66.0     65.9      68.6     66.1     66.2
66.2     66.3      68.4     66.4     66.3

CALIBRATED TEMPERATURES IN DEGREES F
64.1     64.1      64.0     64.2     64.2
64.0     64.2      63.9     63.9     64.2
64.0     64.4      66.3     64.3     63.8
63.8     64.1     145.0     64.5     64.2
64.5     64.4      79.1     64.3     64.3
64.2     64.3      70.3     63.9     64.0
63.9     64.0      68.2     64.0     64.0
64.1     64.0      66.5     64.0     64.1
64.0     64.2      66.1     64.2     64.0

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 64.001    64.007    63.802
THETA1=        1.0000000
THETA2=         .4171876
```

```
THETA3=         .2823656
THETA4=         .1713571
THETA5=         .1439298

H=   94.720 W/m2C                    ReH=516.807
NUSSELT#= 30.082
FREESTREAM VELOCITY =  1.506 m/s=  4.940 ft/s
Qin=  4.126 Watts      Qloss=    .228 Watts      CONDUCTIVITY=    .040 W/mC
TAMB= 17.743 C           VISCOSITY= .00003700 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     17.8           17.9            17.8           17.9           17.9
     17.8           17.9            17.7           17.7           17.9
     17.8           18.0            19.1           17.9           17.6
     17.7           17.9            62.8           18.0           17.9
     18.1           18.0            26.2           17.9           18.0
     17.9           17.9            21.3           17.7           17.8
     17.7           17.8            20.1           17.8           17.8
     17.8           17.8            19.2           17.8           17.8
     17.8           17.9            19.0           17.9           17.8

THE HEATED CUBE IS IN COLUMN 3 AND ROW  5
BAROMETRIC PRESSURE   30.286 INCHES OF Hg
PITOT-STATIC TUBE DELTA .00560 INCHES WATER
VOLTS  2.6970     AMPS  1.4000
CHANNEL HEIGHT RATIO 1.0

THE INPUT TEMPERATURE ARRAY IN DEGREES F
65.9     65.9       65.9     66.1     66.0
65.9     65.9       65.7     65.6     66.6
66.5     66.6       66.4     66.4     66.1
66.1     66.1       69.4     70.7     70.4
70.8     70.4      143.9     70.2     70.2
69.9     69.9       83.1     65.9     66.0
65.8     66.0       72.3     66.1     65.9
66.1     66.0       69.7     66.1     66.2
66.2     66.3       68.9     66.5     66.4

CALIBRATED TEMPERATURES IN DEGREES F
64.1     64.1       64.1     64.3     64.3
64.2     64.3       64.1     64.0     64.2
64.1     64.2       64.0     64.2     63.8
63.9     64.0       67.2     64.8     64.5
64.9     64.7      139.4     64.5     64.5
64.3     64.4       77.7     64.0     64.1
64.0     64.1       70.5     64.2     64.1
64.2     64.1       67.6     64.0     64.1
64.0     64.2       66.6     64.3     64.1

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 64.101    64.007    63.802
THETA1=        1.0000000
THETA2=         .4788637
THETA3=         .2684694
THETA4=         .1938155

H=   93.091 W/m2C                    ReH=   516.7949000
NUSSELT#= 29.563
FREESTREAM VELOCITY =  1.506 m/s=  4.940 ft/s
Qin=  3.776 Watts    Qloss=    .212 Watts      CONDUCTIVITY=    .040 W/mC
TAMB= 17.761 C           VISCOSITY= .00003701 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     17.8           17.9            17.9           18.0           17.9
     17.9           18.0            17.8           17.8           17.9
     17.8           17.9            17.8           17.9           17.6
     17.7           17.8            19.6           18.2           18.1
     18.3           18.1            59.7           18.1           18.1
     17.9           18.0            25.4           17.8           17.8
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        17.8          17.9            21.4          17.9          17.8
        17.9          17.8            19.8          17.8          17.8
        17.8          17.9            19.2          17.9          17.8


THE HEATED CUBE IS IN COLUMN 3 AND ROW  6
BAROMETRIC PRESSURE   30.286 INCHES OF Hg
PITOT-STATIC TUBE DELTA .00560 INCHES WATER
VOLTS  2.4840     AMPS  1.9000
CHANNEL HEIGHT RATIO 1.0

THE INPUT TEMPERATURE ARRAY IN DEGREES F
66.3      66.3       66.3      66.4      66.3
66.2      66.2       66.0      66.0      67.0
66.8      66.9       66.6      66.7      66.6
66.4      66.5       66.5      71.0      70.8
71.0      70.5       72.8      70.4      70.5
70.2      70.1      162.0      66.1      66.3
66.0      66.3       77.2      66.3      66.2
66.3      66.2       71.6      66.4      66.6
66.5      66.6       69.6      66.7      66.7

CALIBRATED TEMPERATURES IN DEGREES F
64.5      64.5       64.5      64.6      64.6
64.5      64.6       64.4      64.4      64.6
64.4      64.5       64.2      64.5      64.3
64.2      64.4       64.3      65.1      64.9
65.1      64.8       67.1      64.7      64.8
64.6      64.6      157.5      64.2      64.4
64.2      64.4       75.4      64.4      64.4
64.4      64.3       69.6      64.3      64.5
64.3      64.5       67.3      64.5      64.4

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 64.402     64.410     64.203
THETA1=         1.0000000
THETA2=          .4705607
THETA3=          .2692943

H=   94.253 W/m2C                 ReH=   516.6631000
NUSSELT#= 29.921
FREESTREAM VELOCITY =  1.506 m/s=  4.942 ft/s
Qin=  4.720 Watts   Qloss=    .262 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 17.966 C           VISCOSITY= .00003703 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     18.1          18.1            18.1          18.1          18.1
     18.1          18.1            18.0          18.0          18.1
     18.0          18.0            17.9          18.0          17.9
     17.9          18.0            18.0          18.4          18.3
     18.4          18.2            19.5          18.2          18.2
     18.1          18.1            69.7          17.9          18.0
     17.9          18.0            24.1          18.0          18.0
     18.0          17.9            20.9          17.9          18.1
     17.9          18.0            19.6          18.0          18.0

THE HEATED CUBE IS IN COLUMN 3 AND ROW  1
BAROMETRIC PRESSURE   29.865 INCHES OF Hg
PITOT-STATIC TUBE DELTA .02200 INCHES WATER
VOLTS  3.9610     AMPS  1.9000
CHANNEL HEIGHT RATIO 1.0

THE INPUT TEMPERATURE ARRAY IN DEGREES F
68.5      68.5      164.6      68.7      68.5
68.4      68.4       76.8      68.2      69.1
69.0      68.9       72.7      68.9      68.7
68.6      68.4       71.6      72.8      72.6
72.5      72.5       74.5      72.5      72.3
72.2      72.1       74.1      68.5      68.4
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68.1      68.3      70.3      68.7      68.3
68.4      68.3      69.9      69.0      68.6
68.7      68.5      70.0      69.3      68.7

CALIBRATED TEMPERATURES IN DEGREES F
67.0      67.0     163.5      67.2      67.0
66.9      67.1      75.5      66.8      66.7
66.6      66.7      70.4      66.8      66.4
66.5      66.4      69.6      66.6      66.5
66.4      66.5      68.7      66.6      66.5
66.4      66.4      68.5      66.8      66.6
66.4      66.5      68.6      66.9      66.6
66.6      66.5      67.8      66.9      66.5
66.5      66.4      67.8      67.1      66.5

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 66.705    66.625    66.609
THETA1=       1.0000000
THETA2=        .4272328
THETA3=        .3293090
THETA4=        .2270755
THETA5=        .2041866
THETA6=        .2236516
THETA7=        .1355750
THETA8=        .1330826

H=  144.593 W/m2C                ReH=  1029.6060000
NUSSELT#= 45.789
FREESTREAM VELOCITY =  3.013 m/s=  9.886 ft/s
Qin=  7.526 Watts   Qloss=   .272 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 19.248 C            VISCOSITY= .00003717 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     19.4         19.4          73.0          19.6          19.4
     19.4         19.5          24.2          19.3          19.3
     19.2         19.3          21.3          19.3          19.1
     19.2         19.1          20.9          19.2          19.1
     19.1         19.2          20.4          19.2          19.1
     19.1         19.1          20.3          19.4          19.2
     19.1         19.1          20.3          19.4          19.2
     19.2         19.2          19.9          19.4          19.2
     19.2         19.1          19.9          19.5          19.2


THE HEATED CUBE IS IN COLUMN 3 AND ROW  2
BAROMETRIC PRESSURE   29.865 INCHES OF Hg
PITOT-STATIC TUBE DELTA .02200 INCHES WATER
VOLTS  4.1940     AMPS  1.9000
CHANNEL HEIGHT RATIO 1.0

THE INPUT TEMPERATURE ARRAY IN DEGREES F
68.7      68.7      70.0      69.1      68.9
68.7      68.7     169.5      68.5      69.4
69.2      69.4      79.0      69.2      69.1
68.8      68.8      73.4      73.2      72.9
72.9      72.8      75.5      72.8      72.7
72.6      72.5      74.8      68.8      68.7
68.4      68.6      70.9      69.1      68.7
68.7      68.6      70.3      69.3      69.0
69.0      69.0      70.5      69.6      69.2

CALIBRATED TEMPERATURES IN DEGREES F
67.2      67.2      68.6      67.6      67.4
67.2      67.4     169.0      67.1      67.0
66.8      67.2      76.8      67.1      66.8
66.7      66.8      71.4      67.0      66.8
66.8      66.8      69.7      66.9      66.9
66.8      66.8      69.2      67.1      66.9
66.7      66.8      69.2      67.3      67.0
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66.9     66.8      68.2     67.2     66.9
66.8     66.9      68.3     67.4     67.0

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 67.106    67.028    67.010
THETA1=       1.0000000
THETA2=         .4442505
THETA3=         .2697625
THETA4=         .2172257
THETA5=         .2237964
THETA6=         .1233546
THETA7=         .1311951

H=  145.438 W/m2C                  ReH=  1029.3210000
NUSSELT#= 46.037
FREESTREAM VELOCITY =  3.014 m/s=  9.890 ft/s
Qin=  7.969 Watts   Qloss=   .286 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 19.471 C            VISCOSITY= .00003719 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     19.6         19.5          20.3         19.8         19.7
     19.6         19.6          76.1         19.5         19.4
     19.3         19.5          24.9         19.5         19.3
     19.3         19.4          21.9         19.5         19.3
     19.3         19.3          20.9         19.4         19.4
     19.3         19.3          20.6         19.5         19.4
     19.3         19.3          20.7         19.6         19.4
     19.4         19.3          20.1         19.6         19.4
     19.3         19.4          20.2         19.7         19.4

THE HEATED CUBE IS IN COLUMN 3 AND ROW  3
BAROMETRIC PRESSURE   29.888 INCHES OF Hg
PITOT-STATIC TUBE DELTA .02220 INCHES WATER
VOLTS  2.8416     AMPS  1.4950
CHANNEL HEIGHT RATIO 1.0

THE INPUT TEMPERATURE ARRAY IN DEGREES F
65.5     65.5      65.5     65.9     65.8
65.4     65.6      65.9     65.3     66.5
66.1     66.4     119.6     66.3     66.0
65.7     65.9      71.8     70.4     70.1
70.3     69.9      72.6     69.8     70.0
69.6     69.6      71.1     65.5     65.8
65.4     65.6      67.0     65.7     65.6
65.7     65.5      66.7     65.8     65.9
65.9     65.9      66.9     66.1     66.2

CALIBRATED TEMPERATURES IN DEGREES F
63.7     63.7      63.7     64.1     64.1
63.7     64.0      64.3     63.7     64.1
63.7     64.0     117.6     64.1     63.7
63.5     63.8      69.7     64.5     64.2
64.4     64.2      66.9     64.1     64.3
64.0     64.1      65.5     63.6     63.9
63.6     63.7      65.2     63.8     63.8
63.8     63.6      64.6     63.7     63.8
63.7     63.8      64.6     63.9     63.9

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 63.701    63.705    63.401
THETA1=       1.0000000
THETA2=         .5482168
THETA3=         .3161946
THETA4=         .2679693
THETA5=         .1695479
THETA6=         .1682471

H=  146.363 W/m2C                  ReH=  1036.0670000
NUSSELT#= 46.500
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FREESTREAM VELOCITY =  3.017 m/s=  9.898 ft/s
Qin=  4.248 Watts   Qloss=    .152 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 17.557 C          VISCOSITY= .00003698 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     17.6          17.6            17.6          17.8          17.8
     17.6          17.8            17.9          17.6          17.8
     17.6          17.8            47.6          17.8          17.6
     17.5          17.7            20.9          18.0          17.9
     18.0          17.9            19.4          17.8          18.0
     17.8          17.8            18.6          17.6          17.7
     17.5          17.6            18.5          17.7          17.6
     17.7          17.5            18.1          17.6          17.7
     17.6          17.6            18.1          17.7          17.7

THE HEATED CUBE IS IN COLUMN 3 AND ROW  4
BAROMETRIC PRESSURE   29.888 INCHES OF Hg
PITOT-STATIC TUBE DELTA .02220 INCHES WATER
VOLTS  2.9320      AMPS  1.4950
CHANNEL HEIGHT RATIO 1.0

THE INPUT TEMPERATURE ARRAY IN DEGREES F
65.6      65.6       65.5      65.9      65.9
65.5      65.6       65.3      65.3      66.5
66.2      66.4       67.1      66.2      66.1
65.9      65.8      120.2      70.4      70.2
70.4      69.9       77.0      69.8      70.0
69.6      69.6       72.3      65.5      65.8
65.5      65.6       67.5      65.7      65.7
65.8      65.6       67.1      65.8      66.1
65.9      65.8       67.1      66.1      66.2

CALIBRATED TEMPERATURES IN DEGREES F
63.8      63.8       63.7      64.1      64.2
63.8      64.0       63.7      63.7      64.1
63.8      64.0       64.7      64.0      63.8
63.7      63.7      118.3      64.5      64.3
64.5      64.2       71.4      64.1      64.3
64.0      64.1       66.7      63.6      63.9
63.7      63.7       65.7      63.8      63.9
63.9      63.7       65.0      63.7      64.0
63.7      63.7       64.8      63.9      63.9

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 63.701     63.705    63.401
THETA1=        1.0000000
THETA2=         .4015054
THETA3=         .2724119
THETA4=         .1833620
THETA5=         .1564473

H=  149.014 W/m2C                 ReH=  1036.0670000
NUSSELT#= 47.342
FREESTREAM VELOCITY =  3.017 m/s=  9.898 ft/s
Qin=  4.383 Watts     Qloss=    .154 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 17.557 C          VISCOSITY= .00003698 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     17.7          17.7            17.6          17.8          17.9
     17.7          17.8            17.6          17.6          17.8
     17.7          17.8            18.2          17.8          17.6
     17.6          17.6            48.0          18.0          18.0
     18.1          17.9            21.9          17.8          18.0
     17.8          17.8            19.3          17.6          17.7
     17.6          17.6            18.7          17.7          17.7
     17.7          17.6            18.4          17.6          17.8
     17.6          17.6            18.2          17.7          17.7
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THE HEATED CUBE IS IN COLUMN 3 AND ROW  5
BAROMETRIC PRESSURE   29.888 INCHES OF Hg
PITOT-STATIC TUBE DELTA .02220 INCHES WATER
VOLTS  2.8400     AMPS  1.5000
CHANNEL HEIGHT RATIO 1.0

THE INPUT TEMPERATURE ARRAY IN DEGREES F
65.7      65.7       65.6      65.9      65.9
65.6      65.7       65.5      65.4      66.6
66.2      66.4       66.1      66.3      66.0
65.8      65.9       65.4      70.6      70.3
70.6      70.1      121.1      70.0      70.1
69.6      69.6       76.3      65.7      65.9
65.5      65.7       68.8      65.8      65.8
65.9      65.7       67.7      65.9      66.1
66.0      65.9       67.5      66.2      66.3

CALIBRATED TEMPERATURES IN DEGREES F
63.9      63.9       63.8      64.1      64.2
63.9      64.1       63.9      63.8      64.2
63.8      64.0       63.7      64.1      63.7
63.6      63.8       63.2      64.7      64.4
64.7      64.4      116.2      64.3      64.4
64.0      64.1       70.8      63.8      64.0
63.7      63.8       67.0      63.9      64.0
64.0      63.8       65.6      63.8      64.0
63.8      63.8       65.2      64.0      64.0

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 63.801    63.805    63.601
THETA1=       1.0000000
THETA2=        .4670710
THETA3=        .2695867
THETA4=        .2110019

H=  150.936 W/m2C                ReH=  1035.9700000
NUSSELT#= 47.946
FREESTREAM VELOCITY =  3.017 m/s=  9.900 ft/s
Qin=  4.260 Watts   Qloss=   .148 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 17.631 C            VISCOSITY= .00003699 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
      17.7           17.7              17.7           17.8           17.9
      17.7           17.9              17.7           17.7           17.9
      17.7           17.8              17.6           17.8           17.6
      17.6           17.7              17.3           18.2           18.0
      18.2           18.0              46.8           17.9           18.0
      17.8           17.8              21.5           17.7           17.8
      17.6           17.7              19.5           17.7           17.8
      17.8           17.6              18.7           17.7           17.8
      17.7           17.6              18.5           17.8           17.8

THE HEATED CUBE IS IN COLUMN 3 AND ROW  6
BAROMETRIC PRESSURE   29.888 INCHES OF Hg
PITOT-STATIC TUBE DELTA .02220 INCHES WATER
VOLTS  2.8100     AMPS  2.0400
CHANNEL HEIGHT RATIO 1.0

THE INPUT TEMPERATURE ARRAY IN DEGREES F
65.9      66.2       66.1      65.8      66.1
65.7      65.8       65.6      65.6      66.7
66.3      66.5       66.2      66.4      66.2
66.0      66.1       66.0      70.8      70.5
70.7      70.2       71.5      70.1      70.2
69.8      69.7      139.0      65.8      66.1
65.6      65.9       72.4      65.9      65.9
66.0      65.8       69.2      66.0      66.3
66.1      66.1       68.1      66.3      66.4
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CALIBRATED TEMPERATURES IN DEGREES F
64.1      64.4       64.3      64.0      64.4
64.0      64.2       64.0      64.0      64.3
63.9      64.1       63.8      64.2      63.9
63.8      64.0       63.8      64.9      64.6
64.8      64.5       65.8      64.4      64.5
64.2      64.2      134.2      63.9      64.2
63.8      64.0       70.6      64.0      64.1
64.1      63.9       67.1      63.9      64.2
63.9      64.0       65.8      64.1      64.1

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 64.001    64.007    63.802
THETA1=         1.0000000
THETA2=          .4793034
THETA3=          .2819515

H=  151.730 W/m2C                   ReH=  1035.8260000
NUSSELT#= 48.187
FREESTREAM VELOCITY =  3.018 m/s=  9.902 ft/s
Qin=  5.732 Watts   Qloss=   .198 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 17.743 C            VISCOSITY= .00003700 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     17.8            18.0            18.0            17.8            18.0
     17.8            17.9            17.8            17.8            17.9
     17.7            17.8            17.7            17.9            17.7
     17.7            17.8            17.7            18.3            18.1
     18.2            18.0            18.8            18.0            18.1
     17.9            17.9            56.8            17.7            17.9
     17.7            17.8            21.5            17.8            17.8
     17.8            17.7            19.5            17.7            17.9
     17.7            17.8            18.8            17.8            17.8


THE HEATED CUBE IS IN COLUMN 3 AND ROW  1
BAROMETRIC PRESSURE   30.024 INCHES OF Hg
PITOT-STATIC TUBE DELTA .04900 INCHES WATER
VOLTS  4.0650     AMPS  2.0000
CHANNEL HEIGHT RATIO 1.0

THE INPUT TEMPERATURE ARRAY IN DEGREES F
72.2      72.2      157.3      72.5      72.3
72.1      72.1       79.0      71.8      72.7
72.6      72.7       75.7      72.5      72.3
72.2      72.3       74.6      76.7      76.4
76.7      76.4       78.2      76.3      76.1
76.1      76.1       77.7      72.0      72.0
71.9      72.0       73.4      72.3      71.9
72.2      72.0       73.3      72.4      72.3
72.4      72.4       73.4      72.6      72.4

CALIBRATED TEMPERATURES IN DEGREES F
70.6      70.6      155.9      70.9      70.8
70.6      70.8       77.8      70.5      70.7
70.6      70.8       73.8      70.8      70.4
70.5      70.8       72.9      70.9      70.6
71.0      70.7       72.7      70.7      70.6
70.6      70.7       72.4      70.8      70.6
70.7      70.6       72.0      70.9      70.6
70.7      70.6       71.8      70.8      70.5
70.7      70.8       71.5      70.8      70.6

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 70.811    70.803    70.719
THETA1=         1.0000000
THETA2=          .4366989
THETA3=          .2982576
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THETA4=         .2757283
THETA5=         .2299048
THETA6=         .1772431
THETA7=         .1401302
THETA8=         .1064311

H=  177.577 W/m2C                    ReH=  1528.1600000
NUSSELT#= 55.987
FREESTREAM VELOCITY =  4.503 m/s= 14.773 ft/s
Qin=  8.130 Watts   Qloss=   .239 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 21.543 C           VISCOSITY= .00003742 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     21.5         21.4           68.9         21.6         21.6
     21.5         21.5           25.5         21.4         21.5
     21.5         21.5           23.2         21.6         21.3
     21.4         21.6           22.7         21.6         21.5
     21.7         21.5           22.6         21.5         21.5
     21.5         21.5           22.4         21.5         21.4
     21.5         21.4           22.2         21.6         21.4
     21.5         21.4           22.1         21.6         21.4
     21.5         21.6           22.0         21.6         21.5


THE HEATED CUBE IS IN COLUMN 3 AND ROW  2
BAROMETRIC PRESSURE   29.865 INCHES OF Hg
PITOT-STATIC TUBE DELTA .05100 INCHES WATER
VOLTS  4.2000     AMPS  1.9000
CHANNEL HEIGHT RATIO 1.0

THE INPUT TEMPERATURE ARRAY IN DEGREES F
69.2     69.2      69.8     69.6     69.4
69.2     69.2     151.3     68.9     69.9
69.8     69.8      76.0     69.7     69.4
69.3     69.2      72.0     73.6     73.5
73.5     73.3      74.9     73.3     73.2
73.1     73.1      74.4     69.2     69.2
69.0     69.2      70.4     69.4     69.1
69.2     69.1      70.1     69.6     69.5
69.5     69.5      70.3     69.8     69.6

CALIBRATED TEMPERATURES IN DEGREES F
67.7     67.7      68.4     68.1     67.9
67.7     67.9     150.6     67.5     67.5
67.4     67.6      73.8     67.6     67.1
67.2     67.2      70.0     67.5     67.4
67.4     67.3      69.1     67.4     67.4
67.3     67.4      68.8     67.5     67.4
67.3     67.4      68.7     67.6     67.4
67.4     67.3      68.0     67.5     67.4
67.3     67.4      68.1     67.6     67.4

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 67.506    67.532    67.411
THETA1=        1.0000000
THETA2=         .3954129
THETA3=         .2518622
THETA4=         .2030995
THETA5=         .1981020
THETA6=         .0899220
THETA7=         .1022307

H=  178.561 W/m2C                    ReH=  1566.7290000
NUSSELT#= 56.495
FREESTREAM VELOCITY =  4.592 m/s= 15.064 ft/s
Qin=  7.980 Watts   Qloss=   .234 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 19.713 C           VISCOSITY= .00003722 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
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      19.8          19.8            20.2          20.1          20.0
      19.9          19.9            65.9          19.7          19.7
      19.7          19.8            23.2          19.8          19.5
      19.6          19.6            21.1          19.7          19.7
      19.7          19.6            20.6          19.7          19.7
      19.6          19.7            20.4          19.7          19.6
      19.6          19.6            20.4          19.8          19.6
      19.7          19.6            20.0          19.7          19.7
      19.6          19.7            20.1          19.8          19.7


THE HEATED CUBE IS IN COLUMN 3 AND ROW  3
BAROMETRIC PRESSURE   29.687 INCHES OF Hg
PITOT-STATIC TUBE DELTA .04900 INCHES WATER
VOLTS  3.3510      AMPS  1.7500
CHANNEL HEIGHT RATIO 1.0

THE INPUT TEMPERATURE ARRAY IN DEGREES F
64.8      64.8       64.7      65.3      65.2
64.6      64.9       65.2      64.6      65.9
65.3      65.7      125.9      65.6      65.3
64.9      65.1       71.8      69.8      69.5
69.6      69.2       72.2      69.2      69.3
68.9      68.9       70.8      64.9      65.1
64.7      64.8       66.5      65.1      65.0
65.1      64.8       66.2      65.1      65.3
65.1      65.1       66.3      65.4      65.5

CALIBRATED TEMPERATURES IN DEGREES F
63.0      63.0       62.9      63.5      63.5
62.9      63.3       63.6      63.0      63.5
62.9      63.3      123.9      63.4      63.0
62.7      63.0       69.7      63.9      63.6
63.7      63.4       66.5      63.5      63.6
63.3      63.4       65.2      63.0      63.2
62.9      62.9       64.7      63.2      63.2
63.2      62.9       64.1      63.0      63.2
62.9      62.9       64.0      63.2      63.2

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 63.000    63.000    62.799
THETA1=        1.0000000
THETA2=         .5327140
THETA3=         .3391106
THETA4=         .2664897
THETA5=         .1774625
THETA6=         .1617433

H=  178.799 W/m2C                ReH=  1545.1700000
NUSSELT#= 56.845
FREESTREAM VELOCITY =  4.495 m/s= 14.746 ft/s
Qin=  5.864 Watts   Qloss=   .172 Watts    CONDUCTIVITY=   .040 W/mC
TAMB= 17.185 C           VISCOSITY= .00003694 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
      17.2          17.2            17.2          17.5          17.5
      17.2          17.4            17.6          17.2          17.5
      17.2          17.4            51.1          17.4          17.2
      17.1          17.2            20.9          17.7          17.6
      17.6          17.5            19.2          17.5          17.6
      17.4          17.4            18.5          17.2          17.3
      17.2          17.2            18.2          17.3          17.3
      17.3          17.1            17.8          17.2          17.3
      17.2          17.2            17.8          17.3          17.3


THE HEATED CUBE IS IN COLUMN 3 AND ROW  4
BAROMETRIC PRESSURE   29.687 INCHES OF Hg
PITOT-STATIC TUBE DELTA .04900 INCHES WATER
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VOLTS  3.6040      AMPS  1.7500
CHANNEL HEIGHT RATIO 1.0

THE INPUT TEMPERATURE ARRAY IN DEGREES F
64.8      64.8       64.7      65.2      65.1
64.6      64.8       64.5      64.6      65.8
65.3      65.7       66.4      65.5      65.2
64.9      65.1      131.5      69.7      69.5
69.5      69.2       77.3      69.1      69.3
68.9      68.8       72.0      64.8      65.1
64.6      64.8       67.1      65.0      64.9
65.0      64.7       66.6      65.0      65.3
65.1      65.1       66.6      65.3      65.5

CALIBRATED TEMPERATURES IN DEGREES F
63.0      63.0       62.9      63.4      63.4
62.9      63.2       62.9      63.0      63.4
62.9      63.3       64.0      63.3      62.9
62.7      63.0      129.7      63.8      63.6
63.6      63.4       71.7      63.4      63.6
63.3      63.3       66.4      62.9      63.2
62.8      62.9       65.3      63.1      63.1
63.1      62.8       64.5      62.9      63.2
62.9      62.9       64.3      63.1      63.2

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 63.000    62.899    62.699
THETA1=        1.0000000
THETA2=         .4031697
THETA3=         .2783767
THETA4=         .1882048
THETA5=         .1647105

H=  175.591 W/m2C                ReH=  1545.2420000
NUSSELT#= 55.829
FREESTREAM VELOCITY =  4.494 m/s= 14.745 ft/s
Qin=  6.307 Watts   Qloss=   .188 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 17.148 C          VISCOSITY= .00003694 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     17.2          17.2            17.2          17.5          17.4
     17.2          17.4            17.2          17.2          17.4
     17.2          17.4            17.8          17.4          17.1
     17.1          17.2            54.3          17.6          17.6
     17.6          17.5            22.1          17.4          17.6
     17.4          17.4            19.1          17.2          17.3
     17.1          17.2            18.5          17.3          17.3
     17.3          17.1            18.1          17.2          17.3
     17.2          17.2            18.0          17.3          17.3

THE HEATED CUBE IS IN COLUMN 3 AND ROW  5
BAROMETRIC PRESSURE   29.687 INCHES OF Hg
PITOT-STATIC TUBE DELTA .04900 INCHES WATER
VOLTS  3.4120      AMPS  1.7500
CHANNEL HEIGHT RATIO 1.0

THE INPUT TEMPERATURE ARRAY IN DEGREES F
65.0      65.0       64.9      65.3      65.3
64.8      65.0       64.6      64.8      65.9
65.4      65.6       65.3      65.6      65.4
65.1      65.2       66.8      65.9      65.6
69.9      69.3      130.6      69.2      69.5
69.0      68.9       76.5      64.9      65.2
65.8      65.9       68.5      65.1      65.0
65.1      64.9       67.3      65.1      65.3
65.2      66.9       65.4      65.4      65.5

CALIBRATED TEMPERATURES IN DEGREES F
63.2      63.2       63.1      63.5      63.6
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63.1     63.4      63.0     63.2     63.5
63.0     63.2      62.9     63.4     63.1
62.9     63.1      64.6     59.9     59.6
64.0     63.5     125.9     63.5     63.8
63.4     63.4      71.0     63.0     63.3
64.0     64.0      66.7     63.2     63.2
63.2     63.0      65.2     63.0     63.2
63.0     64.8      63.1     63.2     63.2

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 63.100    63.100    62.899
THETA1=        1.0000000
THETA2=         .4645612
THETA3=         .2767180
THETA4=         .0109622

H=  176.686 W/m2C                  ReH=  1545.0620000
NUSSELT#= 56.167
FREESTREAM VELOCITY =  4.495 m/s= 14.747 ft/s
Qin=  5.971 Watts   Qloss=   .177 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 17.241 C          VISCOSITY= .00003695 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     17.3          17.4            17.3          17.5          17.6
     17.3          17.5            17.2          17.4          17.5
     17.2          17.3            17.1          17.4          17.3
     17.2          17.3            18.1          15.5          15.4
     17.8          17.5            52.2          17.5          17.7
     17.4          17.4            21.7          17.2          17.4
     17.8          17.8            19.3          17.3          17.3
     17.3          17.2            18.5          17.2          17.3
     17.2          18.2            17.3          17.3          17.3

THE HEATED CUBE IS IN COLUMN 3 AND ROW  6
BAROMETRIC PRESSURE   29.687 INCHES OF Hg
PITOT-STATIC TUBE DELTA .04900 INCHES WATER
VOLTS  2.5850     AMPS  1.9500
CHANNEL HEIGHT RATIO 1.0

THE INPUT TEMPERATURE ARRAY IN DEGREES F
64.9     64.9      64.8     65.2     65.2
64.7     64.8      64.6     64.7     65.8
65.4     65.5      65.2     65.5     65.2
65.0     65.1      65.1     69.8     69.6
69.8     69.2      70.0     69.2     69.3
69.0     68.8     121.4     64.8     65.1
64.7     64.8      69.0     64.9     65.0
65.1     64.8      67.0     65.0     65.3
65.1     65.1      66.5     65.3     65.5

CALIBRATED TEMPERATURES IN DEGREES F
63.1     63.1      63.0     63.4     63.5
63.0     63.2      63.0     63.1     63.4
63.0     63.1      62.8     63.3     62.9
62.8     63.0      62.9     63.9     63.7
63.9     63.4      64.3     63.5     63.6
63.4     63.3     116.4     62.9     63.2
62.9     62.9      67.2     63.0     63.2
63.2     62.9      64.9     62.9     63.2
62.9     62.9      64.2     63.1     63.2

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 63.000    63.000    62.799
THETA1=        1.0000000
THETA2=         .4654886
THETA3=         .3001426

H=  175.346 W/m2C                  ReH=  1545.1700000
NUSSELT#= 55.747
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FREESTREAM VELOCITY =  4.495 m/s= 14.746 ft/s
Qin=  5.041 Watts   Qloss=   .151 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 17.185 C          VISCOSITY= .00003694 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
      17.3            17.3              17.2            17.5            17.5
      17.2            17.4              17.2            17.3            17.4
      17.2            17.3              17.1            17.4            17.1
      17.1            17.2              17.2            17.7            17.6
      17.7            17.5              17.9            17.5            17.6
      17.4            17.4              46.9            17.2            17.3
      17.2            17.2              19.6            17.2            17.3
      17.3            17.1              18.3            17.2            17.3
      17.2            17.2              17.9            17.3            17.3


THE HEATED CUBE IS IN COLUMN 3 AND ROW  1
BAROMETRIC PRESSURE   30.658 INCHES OF Hg
PITOT-STATIC TUBE DELTA .00550 INCHES WATER
VOLTS  3.9340      AMPS  1.8000
CHANNEL HEIGHT RATIO 2.3

THE INPUT TEMPERATURE ARRAY IN DEGREES F
70.8      70.8       203.3      71.2      71.0
70.7      70.9        84.0      70.6      71.4
71.2      71.4        78.6      71.5      71.0
70.8      70.9        76.5      75.7      75.1
75.3      75.0        79.4      75.2      75.0
74.7      74.9        78.5      71.1      70.8
70.4      70.8        73.9      71.3      70.7
70.8      70.7        73.7      71.4      71.2
71.0      71.1        73.9      71.6      71.3

CALIBRATED TEMPERATURES IN DEGREES F
69.3      69.3       202.2      69.7      69.5
69.1      69.5        82.8      69.3      69.2
68.9      69.3        76.6      69.5      68.9
68.8      69.1        74.5      69.6      69.0
69.2      69.0        73.5      69.3      69.2
68.7      69.3        72.8      69.5      69.0
68.7      69.1        72.2      69.6      69.0
68.9      68.9        71.6      69.3      69.0
68.8      68.8        71.5      69.3      69.0

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 69.609     69.695     69.516
THETA1=        1.0000000
THETA2=         .5298308
THETA3=         .3711366
THETA4=         .2989878
THETA5=         .2432286
THETA6=         .1991213
THETA7=         .1490015
THETA8=         .1460584

H=   74.527 W/m2C                   ReH=  1166.2510000
NUSSELT#= 54.111
FREESTREAM VELOCITY =  1.491 m/s=  4.892 ft/s
Qin=  7.081 Watts   Qloss=   .372 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 20.893 C          VISCOSITY= .00003735 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
      20.7            20.7              94.5            21.0            20.8
      20.6            20.8              28.2            20.7            20.7
      20.5            20.7              24.8            20.8            20.5
      20.5            20.6              23.6            20.9            20.6
      20.7            20.6              23.1            20.7            20.7
      20.4            20.7              22.7            20.8            20.5
      20.4            20.6              22.3            20.9            20.5
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     20.5            20.5               22.0            20.7            20.6
     20.5            20.4               22.0            20.7            20.6


THE HEATED CUBE IS IN COLUMN 3 AND ROW  2
BAROMETRIC PRESSURE   30.658 INCHES OF Hg
PITOT-STATIC TUBE DELTA .00550 INCHES WATER
VOLTS  4.2430      AMPS  1.9300
CHANNEL HEIGHT RATIO 2.3

THE INPUT TEMPERATURE ARRAY IN DEGREES F
70.8      70.8       74.7      71.2      71.0
70.8      70.8      217.9      70.6      71.4
71.3      71.4       88.1      71.3      71.2
71.0      70.9       80.3      75.6      75.2
75.2      75.2       81.4      75.3      75.0
74.8      74.7       79.9      71.1      70.8
70.6      70.8       75.1      71.3      70.8
70.8      70.7       74.5      71.6      71.2
71.0      71.1       74.4      71.7      71.3

CALIBRATED TEMPERATURES IN DEGREES F
69.3      69.3       73.2      69.7      69.5
69.2      69.4      217.8      69.3      69.2
69.0      69.3       86.1      69.3      69.1
69.0      69.1       78.3      69.5      69.1
69.1      69.2       75.6      69.4      69.2
68.8      69.1       74.2      69.5      69.0
68.9      69.1       73.4      69.6      69.1
68.9      68.9       72.4      69.5      69.0
68.8      68.8       72.0      69.4      69.0

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 69.609    69.695    69.717
THETA1=         1.0000000
THETA2=          .5240500
THETA3=          .3580016
THETA4=          .2760395
THETA5=          .2276916
THETA6=          .1636733
THETA7=          .1428837

H=   77.159 W/m2C                   ReH=  1166.1970000
NUSSELT#= 56.018
FREESTREAM VELOCITY =  1.491 m/s=  4.893 ft/s
Qin=  8.189 Watts   Qloss=   .415 Watts     CONDUCTIVITY=    .040 W/mC
TAMB= 20.930 C             VISCOSITY= .00003735 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     20.7            20.7               22.9            21.0            20.8
     20.7            20.8              103.2            20.7            20.7
     20.6            20.7               30.1            20.7            20.6
     20.6            20.6               25.7            20.8            20.6
     20.6            20.7               24.2            20.8            20.7
     20.5            20.6               23.5            20.8            20.5
     20.5            20.6               23.0            20.9            20.6
     20.5            20.5               22.4            20.8            20.6
     20.5            20.4               22.2            20.8            20.6


THE HEATED CUBE IS IN COLUMN 3 AND ROW  3
BAROMETRIC PRESSURE   30.658 INCHES OF Hg
PITOT-STATIC TUBE DELTA .00550 INCHES WATER
VOLTS  3.8320      AMPS  1.9300
CHANNEL HEIGHT RATIO 2.3

THE INPUT TEMPERATURE ARRAY IN DEGREES F
70.9      70.9       70.9      71.1      71.1
70.8      70.9       75.5      70.6      71.7
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71.4      71.8      204.6      71.6      71.3
71.1      71.2       97.3      75.7      75.4
75.4      75.3       88.5      75.3      75.2
74.9      74.9       83.6      71.2      71.0
71.7      71.1       77.5      71.5      70.9
71.0      70.9       76.3      71.6      71.3
71.2      71.3       75.7      71.8      71.5

CALIBRATED TEMPERATURES IN DEGREES F
69.4      69.4       69.4      69.6      69.6
69.2      69.5       74.2      69.3      69.5
69.1      69.7      203.6      69.6      69.2
69.1      69.4       95.4      69.6      69.3
69.3      69.3       82.8      69.4      69.4
68.9      69.3       78.0      69.6      69.2
70.0      69.4       75.8      69.8      69.2
69.1      69.1       74.2      69.5      69.1
69.0      69.0       73.3      69.5      69.2

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 69.709    69.896    69.717
THETA1=         1.0000000
THETA2=          .5079736
THETA3=          .3196352
THETA4=          .2361114
THETA5=          .1719169
THETA6=          .1387121

H=   77.140 W/m2C                   ReH=  1166.1170000
NUSSELT#= 55.998
FREESTREAM VELOCITY =  1.491 m/s=  4.893 ft/s
Qin=  7.396 Watts   Qloss=   .375 Watts     CONDUCTIVITY=    .040 W/mC
TAMB= 20.986 C            VISCOSITY= .00003736 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
      20.8          20.8            20.8          20.9          20.9
      20.7          20.8            23.4          20.7          20.8
      20.6          20.9            95.3          20.9          20.7
      20.6          20.8            35.2          20.9          20.7
      20.7          20.7            28.2          20.8          20.8
      20.5          20.7            25.5          20.9          20.7
      21.1          20.8            24.3          21.0          20.6
      20.6          20.6            23.4          20.8          20.6
      20.6          20.5            23.0          20.8          20.7

THE HEATED CUBE IS IN COLUMN 3 AND ROW  4
BAROMETRIC PRESSURE   30.658 INCHES OF Hg
PITOT-STATIC TUBE DELTA .00550 INCHES WATER
VOLTS  3.9630      AMPS  1.8000
CHANNEL HEIGHT RATIO 2.3

THE INPUT TEMPERATURE ARRAY IN DEGREES F
70.7      70.7       70.6      71.0      70.8
70.6      70.7       70.7      70.5      71.6
71.2      71.6       77.4      71.4      71.1
70.8      70.8      203.0      75.4      75.2
75.2      75.1       98.7      75.0      75.0
74.7      74.9       85.9      70.9      70.9
70.5      70.8       78.3      71.1      70.7
70.8      70.7       76.4      71.2      71.1
71.0      71.0       75.7      71.5      71.3

CALIBRATED TEMPERATURES IN DEGREES F
69.2      69.2       69.1      69.5      69.3
69.0      69.3       69.3      69.2      69.4
68.9      69.5       75.4      69.4      69.0
68.8      69.0      201.7      69.3      69.1
69.1      69.1       93.2      69.1      69.2
68.7      69.3       80.3      69.3      69.1
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68.8     69.1       76.6     69.4     69.0
68.9     68.9       74.3     69.1     68.9
68.8     68.7       73.3     69.2     69.0

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 69.609    69.695    69.516
THETA1=        1.0000000
THETA2=         .4536088
THETA3=         .2979166
THETA4=         .1983913
THETA5=         .1580028

H=   75.377 W/m2C                 ReH=  1166.2510000
NUSSELT#= 54.728
FREESTREAM VELOCITY =  1.491 m/s=  4.892 ft/s
Qin=  7.133 Watts   Qloss=   .370 Watts    CONDUCTIVITY=   .040 W/mC
TAMB= 20.893 C           VISCOSITY= .00003735 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     20.7          20.6            20.6          20.9          20.7
     20.6          20.7            20.7          20.6          20.8
     20.5          20.8            24.1          20.8          20.5
     20.5          20.6            94.3          20.7          20.6
     20.6          20.6            34.0          20.6          20.7
     20.4          20.7            26.8          20.7          20.6
     20.4          20.6            24.8          20.8          20.5
     20.5          20.5            23.5          20.6          20.5
     20.5          20.4            23.0          20.7          20.6


THE HEATED CUBE IS IN COLUMN 3 AND ROW  5
BAROMETRIC PRESSURE   30.658 INCHES OF Hg
PITOT-STATIC TUBE DELTA .00550 INCHES WATER
VOLTS  3.7900     AMPS  1.8000
CHANNEL HEIGHT RATIO 2.3

THE INPUT TEMPERATURE ARRAY IN DEGREES F
70.7     70.7       70.6     70.9     70.8
70.5     70.6       70.4     70.4     71.5
71.2     71.5       71.3     71.2     71.0
70.8     70.9       75.9     75.3     75.1
75.1     74.9      202.6     74.9     74.9
74.7     74.9       97.5     70.7     70.8
70.4     70.7       81.8     70.9     70.7
70.8     70.7       78.0     71.1     71.0
70.9     71.0       76.7     71.4     71.3

CALIBRATED TEMPERATURES IN DEGREES F
69.2     69.2       69.1     69.4     69.3
68.9     69.2       69.0     69.1     69.3
68.9     69.4       69.2     69.2     68.9
68.8     69.1       73.9     69.2     69.0
69.0     68.9      198.8     69.0     69.1
68.7     69.3       92.0     69.0     69.0
68.7     69.0       80.1     69.2     69.0
68.9     68.9       75.9     69.0     68.8
68.7     68.7       74.3     69.1     69.0

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 69.609    69.594    69.416
THETA1=        1.0000000
THETA2=         .4706517
THETA3=         .2823049
THETA4=         .2129837

H=   73.644 W/m2C                 ReH=  1166.3050000
NUSSELT#= 53.474
FREESTREAM VELOCITY =  1.491 m/s=  4.892 ft/s
Qin=  6.822 Watts   Qloss=   .363 Watts    CONDUCTIVITY=   .040 W/mC
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TAMB= 20.856 C          VISCOSITY= .00003735 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     20.7          20.6            20.6          20.8          20.7
     20.5          20.7            20.6          20.6          20.7
     20.5          20.8            20.7          20.7          20.5
     20.5          20.6            23.3          20.7          20.6
     20.6          20.5            92.7          20.5          20.6
     20.4          20.7            33.3          20.6          20.5
     20.4          20.5            26.7          20.7          20.5
     20.5          20.5            24.4          20.6          20.5
     20.4          20.4            23.5          20.6          20.6


THE HEATED CUBE IS IN COLUMN 3 AND ROW  6
BAROMETRIC PRESSURE   30.658 INCHES OF Hg
PITOT-STATIC TUBE DELTA .00550 INCHES WATER
VOLTS  2.7930      AMPS  1.8000
CHANNEL HEIGHT RATIO 2.3

THE INPUT TEMPERATURE ARRAY IN DEGREES F
70.7     70.7       70.6     70.9     70.8
70.5     70.6       70.3     70.4     71.5
71.2     71.5       71.1     71.2     71.0
70.8     70.8       70.9     75.3     75.2
75.2     74.9       77.0     74.8     74.6
74.6     74.8      170.5     70.6     70.8
70.4     70.7       81.3     70.8     70.7
70.8     70.6       76.2     70.8     71.1
70.9     71.0       74.5     71.1     71.3

CALIBRATED TEMPERATURES IN DEGREES F
69.2     69.2       69.1     69.4     69.3
68.9     69.2       68.9     69.1     69.3
68.9     69.4       69.0     69.2     68.9
68.8     69.0       68.9     69.2     69.1
69.1     68.9       71.1     68.9     68.8
68.6     69.2      165.9     68.9     69.0
68.7     69.0       79.6     69.1     69.0
68.9     68.8       74.1     68.7     68.9
68.7     68.7       72.1     68.8     69.0

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 69.609    69.594    69.416
THETA1=        1.0000000
THETA2=         .4501186
THETA3=         .2566145

H=   72.815 W/m2C                   ReH=  1166.3050000
NUSSELT#= 52.872
FREESTREAM VELOCITY =  1.491 m/s=  4.892 ft/s
Qin=  5.027 Watts   Qloss=   .271 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 20.856 C          VISCOSITY= .00003735 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     20.7          20.6            20.6          20.8          20.7
     20.5          20.7            20.5          20.6          20.7
     20.5          20.8            20.6          20.7          20.5
     20.5          20.6            20.5          20.7          20.6
     20.6          20.5            21.7          20.5          20.4
     20.4          20.7            74.4          20.5          20.5
     20.4          20.5            26.5          20.6          20.5
     20.5          20.4            23.4          20.4          20.5
     20.4          20.4            22.3          20.4          20.6


THE HEATED CUBE IS IN COLUMN 3 AND ROW  1
BAROMETRIC PRESSURE   30.658 INCHES OF Hg
PITOT-STATIC TUBE DELTA .02200 INCHES WATER
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VOLTS  3.8850     AMPS  1.8000
CHANNEL HEIGHT RATIO 2.3

THE INPUT TEMPERATURE ARRAY IN DEGREES F
71.3      71.3      143.8     71.6      71.5
71.2      71.3       76.5     71.0      71.9
71.7      71.8       74.8     71.7      71.4
71.2      71.4       73.8     75.8      75.6
75.7      75.4       77.5     75.4      75.3
75.2      75.3       77.0     71.2      71.2
71.0      71.2       72.5     71.4      71.1
71.3      71.2       72.7     71.5      71.5
71.3      71.5       72.8     71.7      71.7

CALIBRATED TEMPERATURES IN DEGREES F
69.8      69.8      142.5     70.1      70.0
69.6      69.9       75.2     69.7      69.7
69.4      69.7       72.7     69.7      69.3
69.2      69.6       71.8     69.7      69.5
69.6      69.4       71.6     69.5      69.5
69.2      69.7       71.3     69.6      69.4
69.3      69.5       70.8     69.7      69.4
69.4      69.4       70.6     69.4      69.3
69.1      69.2       70.4     69.4      69.4

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 70.010    69.896    69.917
THETA1=        1.0000000
THETA2=         .5336266
THETA3=         .3486588
THETA4=         .3170511
THETA5=         .2563253
THETA6=         .1683013
THETA7=         .1179530
THETA8=         .0923567

H=  134.490 W/m2C                    ReH=  2331.9650000
NUSSELT#= 97.613
FREESTREAM VELOCITY =  2.983 m/s=  9.788 ft/s
Qin=  6.993 Watts   Qloss=   .204 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 21.079 C            VISCOSITY= .00003737 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     21.0            21.0             61.4            21.2            21.1
     20.9            21.0             24.0            20.9            20.9
     20.8            20.9             22.6            20.9            20.7
     20.7            20.9             22.1            21.0            20.8
     20.9            20.8             22.0            20.8            20.8
     20.7            21.0             21.8            20.9            20.8
     20.7            20.8             21.6            20.9            20.8
     20.8            20.8             21.4            20.8            20.7
     20.6            20.7             21.3            20.8            20.8


THE HEATED CUBE IS IN COLUMN 3 AND ROW  2
BAROMETRIC PRESSURE   30.658 INCHES OF Hg
PITOT-STATIC TUBE DELTA .02200 INCHES WATER
VOLTS  4.1390     AMPS  1.9000
CHANNEL HEIGHT RATIO 2.3

THE INPUT TEMPERATURE ARRAY IN DEGREES F
71.4      71.4       73.2     71.7      71.5
71.2      71.4      155.8     71.1      72.0
71.7      71.9       79.8     71.8      71.5
71.4      71.4       75.7     75.9      75.6
75.7      75.4       78.6     75.6      75.4
75.2      75.4       77.7     71.4      71.3
70.9      71.2       73.1     71.6      71.2
71.3      71.2       73.0     71.6      71.6
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71.4     71.5      73.1     71.9     71.7

CALIBRATED TEMPERATURES IN DEGREES F
69.9     69.9      71.7     70.2     70.0
69.6     70.0     155.1     69.8     69.8
69.4     69.8      77.8     69.8     69.4
69.4     69.6      73.7     69.8     69.5
69.6     69.4      72.7     69.7     69.6
69.2     69.8      72.0     69.8     69.5
69.2     69.5      71.4     69.9     69.5
69.4     69.4      70.9     69.5     69.4
69.2     69.2      70.7     69.6     69.4

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 70.010    69.997    69.917
THETA1=       1.0000000
THETA2=        .4748241
THETA3=        .3521572
THETA4=        .2587749
THETA5=        .1857150
THETA6=        .1136423
THETA7=        .0962606

H=  128.833 W/m2C               ReH=  2331.9110000
NUSSELT#= 93.503
FREESTREAM VELOCITY =  2.983 m/s=  9.788 ft/s
Qin=  7.864 Watts   Qloss=   .239 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 21.097 C          VISCOSITY= .00003737 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     21.1         21.0           22.0         21.2         21.1
     20.9         21.1           68.4         21.0         21.0
     20.8         21.0           25.4         21.0         20.8
     20.8         20.9           23.2         21.0         20.8
     20.9         20.8           22.6         20.9         20.9
     20.7         21.0           22.2         21.0         20.8
     20.7         20.8           21.9         21.0         20.8
     20.8         20.8           21.6         20.8         20.8
     20.7         20.7           21.5         20.9         20.8


THE HEATED CUBE IS IN COLUMN 3 AND ROW  3
BAROMETRIC PRESSURE   30.658 INCHES OF Hg
PITOT-STATIC TUBE DELTA .02200 INCHES WATER
VOLTS  3.7590     AMPS  1.9200
CHANNEL HEIGHT RATIO 2.3

THE INPUT TEMPERATURE ARRAY IN DEGREES F
71.2     71.2      71.2     71.5     71.4
71.1     71.3      73.0     71.0     72.0
71.7     72.1     155.8     71.8     71.6
71.4     71.5      82.1     75.9     75.6
75.7     75.5      80.8     75.5     75.5
75.3     75.4      78.6     71.4     71.4
71.0     71.3      73.6     71.6     71.2
71.4     71.2      73.4     71.6     71.6
71.5     71.6      73.3     72.0     71.8

CALIBRATED TEMPERATURES IN DEGREES F
69.7     69.7      69.7     70.0     69.9
69.5     69.9      71.7     69.7     69.8
69.4     70.0     154.4     69.8     69.5
69.4     69.7      80.1     69.8     69.5
69.6     69.5      75.0     69.6     69.7
69.3     69.8      72.9     69.8     69.6
69.3     69.6      71.9     69.9     69.5
69.5     69.4      71.3     69.5     69.4
69.3     69.3      70.9     69.7     69.5
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AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 70.010    70.098    69.917
THETA1=       1.0000000
THETA2=        .4899860
THETA3=        .2866377
THETA4=        .1895818
THETA5=        .1242340
THETA6=        .0908313

H=  119.371 W/m2C                 ReH=  2331.8570000
NUSSELT#= 86.633
FREESTREAM VELOCITY =  2.984 m/s=  9.789 ft/s
Qin=  7.217 Watts   Qloss=   .237 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 21.116 C            VISCOSITY= .00003737 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
      21.0            20.9             20.9            21.1            21.1
      20.9            21.0             22.0            20.9            21.0
      20.8            21.1             68.0            21.0            20.8
      20.8            21.0             26.7            21.0            20.8
      20.9            20.8             23.9            20.9            20.9
      20.7            21.0             22.7            21.0            20.9
      20.7            20.9             22.2            21.0            20.8
      20.9            20.8             21.8            20.8            20.8
      20.7            20.7             21.6            20.9            20.8


THE HEATED CUBE IS IN COLUMN 3 AND ROW  4
BAROMETRIC PRESSURE   30.007 INCHES OF Hg
PITOT-STATIC TUBE DELTA .02200 INCHES WATER
VOLTS  3.8570     AMPS  1.9000
CHANNEL HEIGHT RATIO 2.3

THE INPUT TEMPERATURE ARRAY IN DEGREES F
67.7      67.7       67.6      67.9      67.8
67.5      67.6       67.4      67.3      68.5
68.1      68.5       70.9      68.3      67.9
67.7      67.9      155.1      72.5      72.0
72.2      71.9       82.3      72.0      71.9
71.6      71.7       75.7      67.9      67.7
67.4      67.6       70.2      68.2      67.5
67.8      67.5       69.7      68.3      67.9
67.9      67.9       69.6      68.7      68.2

CALIBRATED TEMPERATURES IN DEGREES F
65.9      65.9       65.8      65.9      66.1
65.8      65.9       65.8      65.8      66.3
65.9      66.4       68.8      66.2      65.8
65.7      66.1      153.7      66.2      65.9
66.2      66.0       76.6      66.1      66.1
65.8      66.1       70.1      66.3      66.0
65.8      65.8       68.5      66.5      65.8
66.0      65.7       67.7      66.3      65.8
65.7      65.8       67.3      66.5      65.9

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 66.304    66.420    66.607
THETA1=       1.0000000
THETA2=        .3577057
THETA3=        .2052243
THETA4=        .1282964
THETA5=        .0867538

H=  117.186 W/m2C                 ReH=  2362.7990000
NUSSELT#= 85.370
FREESTREAM VELOCITY =  3.006 m/s=  9.861 ft/s
Qin=  7.328 Watts   Qloss=   .245 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 19.135 C            VISCOSITY= .00003716 m2/s
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SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     18.8         18.8           18.8         18.8         18.9
     18.8         18.9           18.8         18.8         19.0
     18.8         19.1           20.5         19.0         18.8
     18.7         19.0           67.6         19.0         18.8
     19.0         18.9           24.8         19.0         18.9
     18.8         18.9           21.2         19.1         18.9
     18.8         18.8           20.3         19.2         18.8
     18.9         18.7           19.9         19.1         18.8
     18.7         18.8           19.6         19.2         18.8


THE HEATED CUBE IS IN COLUMN 3 AND ROW  5
BAROMETRIC PRESSURE   29.291 INCHES OF Hg
PITOT-STATIC TUBE DELTA .02200 INCHES WATER
VOLTS  3.8250     AMPS  1.4900
CHANNEL HEIGHT RATIO 2.3

THE INPUT TEMPERATURE ARRAY IN DEGREES F
66.5     66.5      66.4     66.8     66.7
66.3     66.4      66.2     66.3     67.4
67.0     67.3      67.0     67.1     66.9
66.6     66.7      68.3     71.2     71.0
71.0     70.8     137.3     70.8     70.8
70.4     70.4      75.1     66.7     66.6
66.2     66.4      68.5     66.9     66.5
66.5     66.4      67.8     67.1     66.8
66.7     66.7      67.8     67.4     66.9

CALIBRATED TEMPERATURES IN DEGREES F
64.7     64.7      64.7     65.0     65.0
64.6     64.8      64.6     64.7     65.2
64.9     65.2      65.0     65.1     64.9
64.7     64.9      66.4     65.2     65.0
65.0     65.0     132.5     64.9     65.0
64.7     64.8      69.5     65.1     64.8
64.8     64.8      67.0     65.3     64.9
64.9     64.8      65.9     65.3     64.9
64.9     65.0      65.9     65.5     64.9

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 64.802    64.911    64.803
THETA1=       1.0000000
THETA2=        .4727159
THETA3=        .2370119
THETA4=        .2342279

H=  117.524 W/m2C               ReH=  2394.1960000
NUSSELT#= 85.763
FREESTREAM VELOCITY =  3.038 m/s=  9.965 ft/s
Qin=  5.699 Watts   Qloss=   .190 Watts    CONDUCTIVITY=   .040 W/mC
TAMB= 18.244 C          VISCOSITY= .00003706 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     18.2         18.2           18.2         18.3         18.3
     18.1         18.2           18.1         18.2         18.4
     18.3         18.4           18.3         18.4         18.3
     18.2         18.3           19.1         18.4         18.4
     18.4         18.3           55.8         18.3         18.4
     18.2         18.2           20.8         18.4         18.2
     18.2         18.2           19.5         18.5         18.3
     18.3         18.2           18.9         18.5         18.3
     18.3         18.3           18.8         18.6         18.3


THE HEATED CUBE IS IN COLUMN 3 AND ROW  6
BAROMETRIC PRESSURE   30.658 INCHES OF Hg
PITOT-STATIC TUBE DELTA .02200 INCHES WATER
VOLTS  3.4000     AMPS  2.2000
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CHANNEL HEIGHT RATIO 2.3

THE INPUT TEMPERATURE ARRAY IN DEGREES F
71.3     71.3      71.2     71.7     71.5
71.2     71.4      71.0     71.2     72.2
71.9     72.2      71.9     72.0     71.6
71.5     71.6      71.5     76.0     75.8
75.8     75.6      77.0     75.5     75.6
75.3     75.4     164.5     71.3     71.5
71.2     71.4      78.3     71.5     71.3
71.5     71.4      74.6     71.5     71.7
71.6     71.7      73.7     71.9     71.9

CALIBRATED TEMPERATURES IN DEGREES F
69.8     69.8      69.7     70.2     70.0
69.6     70.0      69.6     69.9     70.0
69.6     70.1      69.8     70.0     69.5
69.5     69.8      69.5     69.9     69.7
69.7     69.6      71.1     69.6     69.8
69.3     69.8     159.8     69.7     69.7
69.5     69.7      76.6     69.8     69.6
69.6     69.6      72.5     69.4     69.5
69.4     69.4      71.3     69.6     69.6

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 70.110    70.098    70.118
THETA1=       1.0000000
THETA2=        .3624850
THETA3=        .1869672

H=  116.356 W/m2C               ReH=  2331.6970000
NUSSELT#= 84.436
FREESTREAM VELOCITY =  2.984 m/s=  9.789 ft/s
Qin=  7.480 Watts   Qloss=   .252 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 21.172 C          VISCOSITY= .00003738 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     21.0         21.0           20.9         21.2         21.1
     20.9         21.1           20.9         21.0         21.1
     20.9         21.2           21.0         21.1         20.8
     20.8         21.0           20.8         21.1         21.0
     21.0         20.9           21.7         20.9         21.0
     20.7         21.0           71.0         20.9         20.9
     20.8         20.9           24.8         21.0         20.9
     20.9         20.9           22.5         20.8         20.8
     20.8         20.8           21.8         20.9         20.9


THE HEATED CUBE IS IN COLUMN 3 AND ROW  1
BAROMETRIC PRESSURE   30.658 INCHES OF Hg
PITOT-STATIC TUBE DELTA .04900 INCHES WATER
VOLTS  4.2400     AMPS  1.8700
CHANNEL HEIGHT RATIO 2.3

THE INPUT TEMPERATURE ARRAY IN DEGREES F
71.7     71.7     136.6     72.0     71.8
71.6     71.7      76.9     71.3     72.2
72.1     72.3      75.3     72.0     71.8
71.7     71.9      74.2     76.1     75.8
76.1     75.9      77.9     75.7     75.7
75.7     75.7      77.4     71.6     71.6
71.4     71.6      73.0     71.7     71.4
71.8     71.6      73.2     71.8     71.9
71.9     71.9      73.2     72.0     72.0

CALIBRATED TEMPERATURES IN DEGREES F
70.2     70.2     135.3     70.5     70.3
70.0     70.3      75.6     70.0     70.0
69.8     70.2      73.2     70.0     69.7
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69.7     70.1      72.2     70.0     69.7
70.0     69.9      72.0     69.8     69.9
69.7     70.1      71.7     70.0     69.8
69.7     69.9      71.3     70.0     69.7
69.9     69.8      71.1     69.7     69.7
69.7     69.6      70.8     69.7     69.7

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 70.310    70.299    70.218
THETA1=        1.0000000
THETA2=         .5585524
THETA3=         .3568311
THETA4=         .3264903
THETA5=         .2661689
THETA6=         .1971892
THETA7=         .1479937
THETA8=         .1034926

H=  170.219 W/m2C                 ReH=  3479.4350000
NUSSELT#=123.501
FREESTREAM VELOCITY =  4.454 m/s= 14.612 ft/s
Qin=  7.929 Watts   Qloss=   .183 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 21.265 C           VISCOSITY= .00003739 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     21.2          21.2          57.4          21.4          21.3
     21.1          21.3          24.2          21.1          21.1
     21.0          21.2          22.9          21.1          20.9
     21.0          21.2          22.3          21.1          21.0
     21.1          21.1          22.2          21.0          21.1
     21.0          21.2          22.1          21.1          21.0
     20.9          21.0          21.8          21.1          20.9
     21.1          21.0          21.7          21.0          21.0
     21.0          20.9          21.6          20.9          21.0


THE HEATED CUBE IS IN COLUMN 3 AND ROW  2
BAROMETRIC PRESSURE   30.024 INCHES OF Hg
PITOT-STATIC TUBE DELTA .04900 INCHES WATER
VOLTS  4.1500     AMPS  1.9000
CHANNEL HEIGHT RATIO 2.3

THE INPUT TEMPERATURE ARRAY IN DEGREES F
70.8     70.8      72.4     71.0     70.8
70.9     70.7     136.5     70.4     71.2
71.4     71.3      78.0     71.1     70.9
71.0     70.8      74.5     75.1     74.9
75.1     75.0      77.5     74.8     74.6
74.8     74.6      76.8     70.6     70.5
70.5     70.7      72.3     70.7     70.4
70.8     70.6      72.3     70.9     70.9
71.0     71.0      72.3     71.1     70.9

CALIBRATED TEMPERATURES IN DEGREES F
69.2     69.2      70.8     69.4     69.3
69.4     69.4     135.8     69.1     69.2
69.4     69.4      76.2     69.4     69.0
69.3     69.3      72.8     69.3     69.1
69.4     69.3      72.0     69.2     69.1
69.3     69.2      71.5     69.3     69.1
69.3     69.3      70.9     69.3     69.1
69.3     69.2      70.8     69.3     69.1
69.3     69.4      70.4     69.3     69.1

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 69.208    69.292    69.316
THETA1=        1.0000000
THETA2=         .5080414
THETA3=         .3964238
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THETA4=          .3208491
THETA5=          .2396767
THETA6=          .2155451
THETA7=          .1672953

H=  165.408 W/m2C                   ReH=  3518.4090000
NUSSELT#=120.138
FREESTREAM VELOCITY =  4.496 m/s= 14.752 ft/s
Qin=  7.885 Watts    Qloss=   .187 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 20.707 C              VISCOSITY= .00003733 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
      20.7          20.6             21.5          20.8          20.7
      20.8          20.8             57.7          20.6          20.7
      20.8          20.8             24.5          20.8          20.5
      20.7          20.7             22.7          20.7          20.6
      20.8          20.7             22.2          20.7          20.6
      20.7          20.7             21.9          20.7          20.6
      20.7          20.7             21.6          20.7          20.6
      20.7          20.7             21.5          20.7          20.6
      20.7          20.8             21.3          20.7          20.6


THE HEATED CUBE IS IN COLUMN 3 AND ROW  3
BAROMETRIC PRESSURE   30.024 INCHES OF Hg
PITOT-STATIC TUBE DELTA .04900 INCHES WATER
VOLTS  3.6500     AMPS  1.8700
CHANNEL HEIGHT RATIO 2.3

THE INPUT TEMPERATURE ARRAY IN DEGREES F
71.5      71.5       71.4      71.6      71.5
71.5      71.5       72.3      71.2      72.2
72.2      72.3      131.7      71.9      71.8
71.8      71.6       77.2      75.9      75.7
76.0      75.8       78.4      75.6      75.5
75.6      75.5       77.2      71.4      71.5
71.3      71.5       72.7      71.6      71.3
71.6      71.5       72.8      71.6      71.7
71.8      71.8       72.8      71.9      71.8

CALIBRATED TEMPERATURES IN DEGREES F
69.9      69.9       69.8      70.0      70.0
70.0      70.2       71.1      69.9      70.2
70.2      70.4      130.3      70.2      69.9
70.1      70.1       75.5      70.1      69.9
70.3      70.1       72.9      70.0      70.0
70.1      70.1       71.9      70.2      70.1
70.1      70.1       71.3      70.2      70.0
70.1      70.1       71.3      70.0      69.9
70.1      70.2       70.9      70.1      70.0

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 70.110    70.199    70.118
THETA1=        1.0000000
THETA2=         .5195871
THETA3=         .3266883
THETA4=         .2211323
THETA5=         .2092143
THETA6=         .1465864

H=  158.356 W/m2C                   ReH=  3516.3030000
NUSSELT#=114.910
FREESTREAM VELOCITY =  4.500 m/s= 14.764 ft/s
Qin=  6.826 Watts    Qloss=   .169 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 21.190 C              VISCOSITY= .00003738 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
      21.1          21.0             21.0          21.1          21.1
      21.1          21.2             21.7          21.0          21.2
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        21.2          21.3           54.6          21.2          21.0
        21.2          21.2           24.2          21.2          21.1
        21.3          21.2           22.7          21.1          21.1
        21.2          21.2           22.2          21.2          21.2
        21.2          21.1           21.8          21.2          21.1
        21.2          21.2           21.8          21.1          21.1
        21.2          21.2           21.6          21.2          21.1


THE HEATED CUBE IS IN COLUMN 3 AND ROW  4
BAROMETRIC PRESSURE   30.024 INCHES OF Hg
PITOT-STATIC TUBE DELTA .04900 INCHES WATER
VOLTS  3.8600     AMPS  1.8700
CHANNEL HEIGHT RATIO 2.3

THE INPUT TEMPERATURE ARRAY IN DEGREES F
71.6     71.6       71.4     71.7     71.5
71.5     71.5       71.2     71.2     72.2
71.1     71.3       73.3     72.0     71.8
71.8     71.7      134.9     76.0     75.8
76.1     75.8       81.6     75.7     75.6
75.5     75.5       78.0     71.4     71.5
71.4     71.6       73.1     71.5     71.4
71.6     71.5       73.1     71.6     71.8
71.9     71.9       73.0     71.9     71.8

CALIBRATED TEMPERATURES IN DEGREES F
70.0     70.0       69.8     70.1     70.0
70.0     70.2       69.9     69.9     70.2
69.1     69.4       71.4     70.3     69.9
70.1     70.2      133.5     70.2     70.0
70.4     70.1       76.2     70.1     70.1
70.0     70.1       72.7     70.2     70.1
70.2     70.2       71.7     70.1     70.1
70.1     70.1       71.6     70.0     70.0
70.2     70.3       71.1     70.1     70.0

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 70.210    70.199    70.118
THETA1=        1.0000000
THETA2=         .4205808
THETA3=         .2582320
THETA4=         .2312055
THETA5=         .1584733

H=  159.064 W/m2C                  ReH=  3516.2230000
NUSSELT#=115.420
FREESTREAM VELOCITY =  4.500 m/s= 14.764 ft/s
Qin=  7.218 Watts   Qloss=   .178 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 21.209 C          VISCOSITY= .00003738 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
        21.1          21.1           21.0          21.2          21.1
        21.1          21.2           21.1          21.0          21.2
        20.6          20.8           21.9          21.3          21.0
        21.2          21.2           56.4          21.2          21.1
        21.4          21.2           24.5          21.2          21.2
        21.1          21.2           22.6          21.2          21.2
        21.2          21.2           22.1          21.2          21.1
        21.2          21.2           22.0          21.1          21.1
        21.2          21.3           21.7          21.2          21.1


THE HEATED CUBE IS IN COLUMN 3 AND ROW  5
BAROMETRIC PRESSURE   30.024 INCHES OF Hg
PITOT-STATIC TUBE DELTA .04900 INCHES WATER
VOLTS  3.8510     AMPS  1.8700
CHANNEL HEIGHT RATIO 2.3
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THE INPUT TEMPERATURE ARRAY IN DEGREES F
71.7     71.7      71.6     71.8     71.7
71.6     71.6      71.4     71.3     72.3
72.3     72.3      72.1     72.1     71.9
71.9     71.8      73.5     76.2     75.9
76.4     76.0     138.2     75.7     75.8
75.7     75.7      80.8     71.5     71.6
71.6     71.6      73.9     71.6     71.6
71.8     71.6      73.4     71.8     71.9
72.0     72.0      73.3     72.0     72.0

CALIBRATED TEMPERATURES IN DEGREES F
70.1     70.1      70.0     70.2     70.2
70.1     70.3      70.1     70.0     70.3
70.3     70.4      70.2     70.4     70.0
70.2     70.3      71.8     70.4     70.1
70.7     70.3     133.7     70.1     70.3
70.2     70.3      75.5     70.3     70.2
70.4     70.2      72.5     70.2     70.3
70.3     70.2      71.9     70.2     70.1
70.3     70.4      71.4     70.2     70.2

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 70.310    70.299    70.318
THETA1=       1.0000000
THETA2=        .4241963
THETA3=        .2977211
THETA4=        .2139158

H=  158.465 W/m2C               ReH=  3515.9000000
NUSSELT#=114.969
FREESTREAM VELOCITY =  4.501 m/s= 14.766 ft/s
Qin=  7.201 Watts   Qloss=   .179 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 21.283 C          VISCOSITY= .00003739 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     21.2         21.1           21.1         21.2         21.2
     21.2         21.3           21.2         21.1         21.3
     21.3         21.3           21.2         21.3         21.1
     21.2         21.3           22.1         21.3         21.2
     21.5         21.3           56.5         21.2         21.3
     21.2         21.3           24.2         21.3         21.2
     21.3         21.2           22.5         21.2         21.3
     21.3         21.2           22.1         21.2         21.2
     21.3         21.3           21.9         21.2         21.2


THE HEATED CUBE IS IN COLUMN 3 AND ROW  6
BAROMETRIC PRESSURE   30.024 INCHES OF Hg
PITOT-STATIC TUBE DELTA .04900 INCHES WATER
VOLTS  3.7500     AMPS  2.2600
CHANNEL HEIGHT RATIO 2.3

THE INPUT TEMPERATURE ARRAY IN DEGREES F
71.6     71.6      71.5     71.7     71.6
71.6     71.6      71.3     71.3     72.2
71.2     72.1      71.9     72.0     71.8
71.9     71.7      71.7     76.2     75.8
76.3     75.9      76.9     75.7     75.7
75.6     75.6     149.6     71.4     71.5
71.4     71.6      76.1     71.5     71.4
71.7     71.5      74.0     71.6     71.9
71.9     71.9      73.4     71.9     71.9

CALIBRATED TEMPERATURES IN DEGREES F
70.0     70.0      69.9     70.1     70.1
70.1     70.3      70.0     70.0     70.2
69.2     70.2      70.0     70.3     69.9
70.2     70.2      70.0     70.4     70.0
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70.6      70.2       71.4      70.1      70.2
70.1      70.2      145.1      70.2      70.1
70.2      70.2       74.7      70.1      70.1
70.2      70.1       72.5      70.0      70.1
70.2      70.3       71.5      70.1      70.1

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 70.310    70.299    70.218
THETA1=       1.0000000
THETA2=        .4926057
THETA3=        .2811364

H=  157.971 W/m2C                ReH=  3515.9800000
NUSSELT#=114.615
FREESTREAM VELOCITY =  4.501 m/s= 14.766 ft/s
Qin=  8.475 Watts   Qloss=   .211 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 21.265 C          VISCOSITY= .00003739 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     21.1           21.1            21.0           21.2           21.2
     21.2           21.3            21.1           21.1           21.2
     20.7           21.2            21.1           21.3           21.0
     21.2           21.2            21.1           21.3           21.1
     21.5           21.2            21.9           21.2           21.2
     21.2           21.2            62.9           21.2           21.2
     21.2           21.2            23.7           21.2           21.1
     21.2           21.2            22.5           21.1           21.2
     21.2           21.3            22.0           21.2           21.2


THE HEATED CUBE IS IN COLUMN 3 AND ROW  1
BAROMETRIC PRESSURE   30.024 INCHES OF Hg
PITOT-STATIC TUBE DELTA .00550 INCHES WATER
VOLTS  3.4650     AMPS  1.8000
CHANNEL HEIGHT RATIO 4.6

THE INPUT TEMPERATURE ARRAY IN DEGREES F
71.5      71.5      195.7      72.0      71.7
71.3      71.6       86.1      71.5      72.2
71.8      72.2       80.2      72.5      71.6
71.4      71.7       77.6      77.0      75.9
75.9      75.9       80.4      76.4      75.7
75.4      75.7       79.1      72.3      71.6
71.2      71.8       74.5      71.6      71.4
71.6      71.7       72.8      72.8      71.8
71.7      72.0       74.2      73.0      72.0

CALIBRATED TEMPERATURES IN DEGREES F
69.9      69.9      194.5      70.4      70.2
69.8      70.3       85.0      70.2      70.2
69.8      70.3       78.4      70.8      69.7
69.7      70.2       75.9      71.2      70.1
70.2      70.2       75.0      70.8      70.2
69.9      70.3       73.8      71.1      70.2
70.0      70.4       73.1      70.2      70.1
70.1      70.3       71.3      71.2      70.0
70.0      70.4       72.3      71.2      70.2

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 70.310    70.400    70.218
THETA1=       1.0000000
THETA2=        .5507835
THETA3=        .3807500
THETA4=        .3167980
THETA5=        .2388533
THETA6=        .1919971
THETA7=        .0648929
THETA8=        .1376179
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H=   70.098 W/m2C                   ReH=  2355.8610000
NUSSELT#=101.714
FREESTREAM VELOCITY =  1.508 m/s=  4.947 ft/s
Qin=  6.237 Watts   Qloss=   .348 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 21.283 C             VISCOSITY= .00003739 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
      21.1            21.0              90.3            21.4            21.2
      21.0            21.3              29.4            21.2            21.2
      21.0            21.3              25.8            21.6            20.9
      21.0            21.2              24.4            21.8            21.2
      21.2            21.2              23.9            21.6            21.2
      21.1            21.3              23.2            21.7            21.2
      21.1            21.3              22.8            21.2            21.1
      21.2            21.3              21.8            21.8            21.1
      21.1            21.3              22.4            21.8            21.2

THE HEATED CUBE IS IN COLUMN 3 AND ROW  2
BAROMETRIC PRESSURE   29.996 INCHES OF Hg
PITOT-STATIC TUBE DELTA .00550 INCHES WATER
VOLTS  3.0540      AMPS  1.4100
CHANNEL HEIGHT RATIO 4.6

THE INPUT TEMPERATURE ARRAY IN DEGREES F
64.6       64.4       67.3       64.9       64.7
64.4       64.6      147.5       64.2       65.1
65.0       65.2       73.7       65.0       64.7
64.6       64.8       69.2       69.2       68.8
69.0       69.0       72.1       68.7       68.6
68.5       68.6       70.9       64.5       64.4
64.5       64.7       66.4       64.6       64.3
64.6       64.7       66.3       64.8       64.6
64.8       65.1       66.3       65.0       64.7

CALIBRATED TEMPERATURES IN DEGREES F
62.8       62.6       65.6       63.1       63.0
62.7       63.0      146.6       62.6       62.9
62.9       63.1       71.7       63.0       62.7
62.7       63.0       67.3       63.1       62.8
63.0       63.1       66.2       62.8       62.8
62.8       63.0       65.2       62.9       62.6
63.1       63.1       64.9       63.0       62.7
63.0       63.1       64.4       63.0       62.7
63.0       63.3       64.4       63.1       62.7

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 62.799     62.997     62.798
THETA1=         1.0000000
THETA2=          .5054042
THETA3=          .3777966
THETA4=          .2650790
THETA5=          .2324113
THETA6=          .1762095
THETA7=          .1755016

H=   71.774 W/m2C                   ReH=  2369.1330000
NUSSELT#=104.975
FREESTREAM VELOCITY =  1.498 m/s=  4.915 ft/s
Qin=  4.306 Watts   Qloss=   .235 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 17.147 C             VISCOSITY= .00003694 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
      17.1            17.0              18.7            17.3            17.2
      17.1            17.2              63.7            17.0            17.1
      17.2            17.3              22.1            17.2            17.0
      17.1            17.2              19.6            17.3            17.1
      17.2            17.3              19.0            17.1            17.1
      17.1            17.2              18.5            17.2            17.0
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     17.3         17.3          18.3         17.2         17.0
     17.2         17.3          18.0         17.2         17.1
     17.2         17.4          18.0         17.3         17.0


THE HEATED CUBE IS IN COLUMN 3 AND ROW  3
BAROMETRIC PRESSURE   29.996 INCHES OF Hg
PITOT-STATIC TUBE DELTA .00550 INCHES WATER
VOLTS  2.9440     AMPS  1.4000
CHANNEL HEIGHT RATIO 4.6

THE INPUT TEMPERATURE ARRAY IN DEGREES F
65.4      65.4       65.5      65.8      65.5
65.2      65.5       68.5      65.0      65.9
65.7      65.9      146.6      65.8      65.5
65.4      65.5       78.7      69.9      69.7
69.8      69.7       76.5      69.6      69.4
69.3      69.4       73.9      65.2      65.2
65.1      65.5       68.5      65.4      65.2
65.4      65.5       68.3      65.5      65.5
65.6      65.0       68.0      65.8      65.6

CALIBRATED TEMPERATURES IN DEGREES F
63.6      63.6       63.7      63.8      63.6
63.4      63.8       67.0      63.6      63.7
63.5      63.6      145.1      63.7      63.5
63.4      63.6       77.0      63.9      63.7
63.6      63.7       70.7      63.8      63.6
63.5      63.8       68.4      63.7      63.5
63.5      63.8       66.8      63.6      63.6
63.6      63.9       66.4      63.7      63.6
63.6      63.0       66.0      63.8      63.6

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 63.700    63.602    63.700
THETA1=        1.0000000
THETA2=         .5267267
THETA3=         .3513099
THETA4=         .2368922
THETA5=         .2078025
THETA6=         .1766453

H=   70.623 W/m2C                  ReH=  2367.8130000
NUSSELT#=103.203
FREESTREAM VELOCITY =  1.499 m/s=  4.918 ft/s
Qin=  4.122 Watts   Qloss=   .229 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 17.593 C            VISCOSITY= .00003699 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     17.6         17.6          17.6         17.7         17.6
     17.5         17.7          19.5         17.6         17.6
     17.5         17.5          62.8         17.6         17.5
     17.4         17.6          25.0         17.7         17.6
     17.6         17.6          21.5         17.7         17.6
     17.5         17.7          20.2         17.6         17.5
     17.5         17.7          19.3         17.5         17.5
     17.6         17.7          19.1         17.6         17.6
     17.6         17.2          18.9         17.7         17.6


THE HEATED CUBE IS IN COLUMN 3 AND ROW  4
BAROMETRIC PRESSURE   29.666 INCHES OF Hg
PITOT-STATIC TUBE DELTA .00550 INCHES WATER
VOLTS  2.7590     AMPS  1.4200
CHANNEL HEIGHT RATIO 4.6

THE INPUT TEMPERATURE ARRAY IN DEGREES F
67.3      67.3       67.3      67.5      67.3
67.2      67.1       67.1      67.1      68.0
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67.9      68.1       71.0      67.9      67.8
67.5      67.4      144.4      71.9      71.6
71.6      71.9       82.0      71.6      71.4
71.3      71.3       75.8      67.5      67.3
67.0      67.3       70.0      67.7      67.2
67.3      67.2       69.5      67.9      67.6
67.5      67.6       69.4      68.2      67.7

CALIBRATED TEMPERATURES IN DEGREES F
65.8      65.8       65.8      66.0      65.8
65.7      65.6       65.7      65.5      65.8
65.7      66.0       68.9      65.9      65.7
65.7      65.6      142.8      65.8      65.6
65.6      66.0       76.3      65.8      65.6
65.6      65.8       70.3      65.9      65.6
65.4      65.5       68.3      65.9      65.6
65.5      65.5       67.5      66.0      65.6
65.5      65.6       67.2      66.1      65.6

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 66.003    66.016    66.006
THETA1=        1.0000000
THETA2=         .4151201
THETA3=         .2255199
THETA4=         .1494618
THETA5=         .1182665

H=   71.146 W/m2C                  ReH=  2377.0710000
NUSSELT#=103.708
FREESTREAM VELOCITY =  1.511 m/s=  4.957 ft/s
Qin=  3.918 Watts   Qloss=   .216 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 18.894 C             VISCOSITY= .00003713 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
    18.8          18.8          18.8          18.9          18.8
    18.7          18.7          18.7          18.6          18.8
    18.7          18.9          20.5          18.8          18.7
    18.7          18.7          61.6          18.8          18.7
    18.6          18.9          24.6          18.8          18.6
    18.7          18.8          21.3          18.9          18.6
    18.5          18.6          20.2          18.8          18.6
    18.6          18.6          19.7          18.9          18.7
    18.6          18.7          19.6          18.9          18.7


THE HEATED CUBE IS IN COLUMN 3 AND ROW  5
BAROMETRIC PRESSURE   29.996 INCHES OF Hg
PITOT-STATIC TUBE DELTA .00550 INCHES WATER
VOLTS  2.8750     AMPS  1.4100
CHANNEL HEIGHT RATIO 4.6

THE INPUT TEMPERATURE ARRAY IN DEGREES F
65.8      65.8       65.6      66.0      65.9
65.6      65.7       65.5      65.4      66.5
66.3      66.6       66.5      66.3      66.1
65.9      66.0       70.6      70.4      70.2
70.3      70.1      146.7      69.9      70.0
69.8      70.0       85.7      65.7      65.7
65.6      66.0       73.0      65.9      65.7
65.9      66.1       71.0      65.9      66.0
66.1      66.4       70.0      66.2      66.2

CALIBRATED TEMPERATURES IN DEGREES F
64.0      64.0       63.9      64.2      64.2
63.9      64.1       63.9      63.8      64.3
64.2      64.5       64.5      64.3      64.1
64.0      64.2       68.8      64.4      64.2
64.3      64.3      142.1      64.0      64.2
64.1      64.4       80.2      64.1      63.9
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64.2      64.4      71.5      64.3      64.1
64.3      64.5      69.2      64.1      64.1
64.3      64.7      68.1      64.3      64.2

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 64.201    64.306    64.202
THETA1=         1.0000000
THETA2=          .4568875
THETA3=          .3081295
THETA4=          .2437028


H=   72.680 W/m2C                ReH=  2366.8800000
NUSSELT#=106.144
FREESTREAM VELOCITY =  1.500 m/s=  4.921 ft/s
Qin=  4.054 Watts   Qloss=   .219 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 17.909 C            VISCOSITY= .00003702 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     17.8          17.8            17.7          17.9          17.9
     17.7          17.9            17.7          17.7          17.9
     17.9          18.0            18.0          17.9          17.8
     17.8          17.9            20.4          18.0          17.9
     18.0          17.9            61.1          17.8          17.9
     17.8          18.0            26.8          17.8          17.7
     17.9          18.0            22.0          17.9          17.8
     18.0          18.0            20.6          17.8          17.8
     17.9          18.2            20.1          17.9          17.9


THE HEATED CUBE IS IN COLUMN 3 AND ROW  6
BAROMETRIC PRESSURE   29.996 INCHES OF Hg
PITOT-STATIC TUBE DELTA .00550 INCHES WATER
VOLTS  2.0930     AMPS  1.4100
CHANNEL HEIGHT RATIO 4.6

THE INPUT TEMPERATURE ARRAY IN DEGREES F
66.0      66.0      65.9      66.2      66.0
65.9      66.0      65.6      65.7      66.7
66.6      66.9      66.4      66.5      66.3
66.2      66.3      66.1      70.6      70.4
70.6      70.3      72.4      70.1      70.2
70.0      70.1     127.2      65.8      66.0
65.8      66.1      72.0      66.0      65.9
66.1      66.1      69.3      66.1      66.3
66.3      66.5      68.4      66.3      66.4

CALIBRATED TEMPERATURES IN DEGREES F
64.2      64.2      64.1      64.2      64.1
64.1      64.3      64.1      64.3      64.5
64.4      64.6      64.3      64.4      64.3
64.2      64.4      64.3      64.6      64.4
64.4      64.4      66.5      64.3      64.4
64.2      64.5     122.3      64.3      64.3
64.2      64.4      70.3      64.2      64.3
64.3      64.5      67.4      64.3      64.4
64.3      64.6      66.4      64.3      64.4

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 64.401    64.408    64.402
THETA1=         1.0000000
THETA2=          .5132454
THETA3=          .3409394

H=   71.158 W/m2C                ReH=  2366.6050000
NUSSELT#=103.903
FREESTREAM VELOCITY =  1.500 m/s=  4.922 ft/s
Qin=  2.951 Watts   Qloss=   .163 Watts     CONDUCTIVITY=   .040 W/mC
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TAMB= 18.002 C          VISCOSITY= .00003703 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
      17.9            17.9              17.9            17.9            17.8
      17.8            18.0              17.8            18.0            18.0
      18.0            18.1              17.9            18.0            17.9
      17.9            18.0              18.0            18.1            18.0
      18.0            18.0              19.2            17.9            18.0
      17.9            18.0              50.2            18.0            17.9
      17.9            18.0              21.3            17.9            17.9
      18.0            18.0              19.7            17.9            18.0
      17.9            18.1              19.1            17.9            18.0


THE HEATED CUBE IS IN COLUMN 3 AND ROW  1
BAROMETRIC PRESSURE   29.666 INCHES OF Hg
PITOT-STATIC TUBE DELTA .02200 INCHES WATER
VOLTS  3.8970      AMPS  1.8900
CHANNEL HEIGHT RATIO 4.6

THE INPUT TEMPERATURE ARRAY IN DEGREES F
66.6      66.6      149.1      67.1      66.8
66.5      66.7       72.8      66.4      67.3
67.1      67.2       70.5      67.2      66.7
66.6      66.9       69.3      71.4      71.0
71.0      70.9       73.0      70.9      70.8
70.5      70.8       72.3      66.8      66.6
66.3      66.7       67.9      67.0      66.5
66.7      66.7       68.0      67.1      66.8
66.7      67.0       68.2      67.3      67.1

CALIBRATED TEMPERATURES IN DEGREES F
65.1      65.0      147.9      65.6      65.3
65.0      65.2       71.5      64.8      65.1
64.9      65.1       68.4      65.2      64.6
64.8      65.1       67.3      65.3      65.0
64.9      65.0       67.1      65.1      64.9
64.8      65.3       66.7      65.2      64.9
64.7      64.9       66.2      65.2      64.9
64.9      65.0       66.0      65.2      64.8
64.7      65.0       66.0      65.2      65.0

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 65.603    65.513    65.304
THETA1=        1.0000000
THETA2=         .4903917
THETA3=         .3131048
THETA4=         .2768086
THETA5=         .2102556
THETA6=         .1256749
THETA7=         .0940354
THETA8=         .0917619

H=  124.665 W/m2C                ReH=  4755.9020000
NUSSELT#=181.825
FREESTREAM VELOCITY =  3.020 m/s=  9.908 ft/s
Qin=  7.365 Watts   Qloss=   .232 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 18.596 C          VISCOSITY= .00003710 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
      18.4            18.4              64.4            18.7            18.5
      18.3            18.5              21.9            18.2            18.4
      18.3            18.4              20.2            18.4            18.1
      18.2            18.4              19.6            18.5            18.4
      18.3            18.3              19.5            18.4            18.3
      18.2            18.5              19.3            18.5            18.3
      18.2            18.3              19.0            18.4            18.3
      18.3            18.3              18.9            18.4            18.2
      18.2            18.3              18.9            18.4            18.3
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THE HEATED CUBE IS IN COLUMN 3 AND ROW  2
BAROMETRIC PRESSURE   29.666 INCHES OF Hg
PITOT-STATIC TUBE DELTA .02200 INCHES WATER
VOLTS  3.8430     AMPS  1.8900
CHANNEL HEIGHT RATIO 4.6

THE INPUT TEMPERATURE ARRAY IN DEGREES F
66.7     66.7       68.4     67.1     66.9
66.4     66.8      150.4     66.4     67.3
67.0     67.2       74.2     67.3     66.7
66.7     66.8       70.5     71.6     70.9
71.0     70.9       73.4     71.1     70.8
70.6     70.7       72.5     67.0     66.6
66.3     66.7       68.0     67.2     66.5
66.7     66.6       67.9     67.4     66.9
66.7     66.9       68.1     67.5     67.1

CALIBRATED TEMPERATURES IN DEGREES F
65.2     65.1       67.0     65.6     65.4
64.9     65.3      149.7     64.8     65.1
64.8     65.1       72.1     65.3     64.6
64.9     65.0       68.6     65.5     64.9
64.9     65.0       67.5     65.3     64.9
64.9     65.2       66.9     65.4     64.9
64.7     64.9       66.3     65.4     64.9
64.9     64.9       65.9     65.5     64.9
64.7     64.9       65.9     65.4     65.0

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 65.302    65.311    65.103
THETA1=       1.0000000
THETA2=        .4805199
THETA3=        .3331070
THETA4=        .2457309
THETA5=        .1574955
THETA6=        .1009766
THETA7=        .0990667

H=  119.988 W/m2C               ReH=  4756.6720000
NUSSELT#=175.048
FREESTREAM VELOCITY =  3.019 m/s=  9.906 ft/s
Qin=  7.263 Watts   Qloss=   .238 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 18.466 C          VISCOSITY= .00003708 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     18.4         18.4           19.4         18.7         18.6
     18.3         18.5           65.4         18.2         18.4
     18.2         18.4           22.3         18.5         18.1
     18.3         18.4           20.3         18.6         18.3
     18.3         18.3           19.7         18.5         18.3
     18.3         18.4           19.4         18.6         18.3
     18.2         18.3           19.1         18.5         18.3
     18.3         18.3           18.9         18.6         18.3
     18.2         18.3           18.8         18.5         18.3


THE HEATED CUBE IS IN COLUMN 3 AND ROW  3
BAROMETRIC PRESSURE   29.884 INCHES OF Hg
PITOT-STATIC TUBE DELTA .02200 INCHES WATER
VOLTS  3.5720     AMPS  1.8000
CHANNEL HEIGHT RATIO 4.6

THE INPUT TEMPERATURE ARRAY IN DEGREES F
65.4     65.4       65.4     65.6     65.6
65.3     65.4       67.5     65.2     66.2
65.9     66.0      147.8     66.0     65.8
65.6     65.6       74.8     70.4     69.9
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70.1      65.7       74.3      69.8      69.7
69.3      69.4       72.3      65.6      65.5
65.2      65.5       67.6      65.8      65.3
65.5      65.4       67.4      65.9      65.7
65.6      65.8       67.4      66.2      65.9

CALIBRATED TEMPERATURES IN DEGREES F
63.6      63.6       63.7      63.9      63.9
63.5      63.8       66.0      63.7      64.0
63.7      63.9      146.3      64.0      63.8
63.6      63.7       72.9      64.4      63.9
64.1      59.8       68.6      64.0      64.0
63.5      63.8       66.6      64.1      63.9
63.6      63.8       65.6      64.1      63.7
63.7      63.7       65.1      64.0      63.8
63.5      63.8       65.2      64.3      63.9

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 63.600    63.703    63.600
THETA1=        1.0000000
THETA2=         .5320663
THETA3=         .3243040
THETA4=         .2154206
THETA5=         .1621243
THETA6=         .1717415

H=  108.515 W/m2C                  ReH=  4744.5610000
NUSSELT#=158.581
FREESTREAM VELOCITY =  3.004 m/s=  9.855 ft/s
Qin=  6.430 Watts   Qloss=    .232 Watts      CONDUCTIVITY=    .040 W/mC
TAMB= 17.575 C              VISCOSITY= .00003699 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     17.6            17.6            17.6           17.7            17.7
     17.5            17.7            18.9           17.6            17.8
     17.6            17.7            63.5           17.8            17.6
     17.6            17.6            22.7           18.0            17.7
     17.8            15.4            20.3           17.8            17.8
     17.5            17.7            19.2           17.8            17.7
     17.5            17.7            18.7           17.8            17.6
     17.6            17.6            18.4           17.8            17.7
     17.5            17.6            18.5           17.9            17.7


THE HEATED CUBE IS IN COLUMN 3 AND ROW  4
BAROMETRIC PRESSURE   29.666 INCHES OF Hg
PITOT-STATIC TUBE DELTA .02200 INCHES WATER
VOLTS  3.6360     AMPS  1.8900
CHANNEL HEIGHT RATIO 4.6

THE INPUT TEMPERATURE ARRAY IN DEGREES F
66.7      66.7       66.7      67.1      67.0
66.6      66.8       66.6      66.5      67.5
67.3      67.5       70.3      67.4      67.1
66.9      67.0      158.2      71.5      71.2
71.3      71.1       81.9      71.1      71.0
70.7      70.9       75.2      67.0      66.8
66.5      66.9       69.5      67.3      66.7
66.9      66.8       69.0      67.4      67.1
67.0      67.1       68.9      67.7      67.2

CALIBRATED TEMPERATURES IN DEGREES F
65.2      65.1       65.2      65.6      65.5
65.1      65.3       65.2      64.9      65.3
65.1      65.4       68.2      65.4      65.0
65.1      65.2      156.7      65.4      65.2
65.2      65.2       76.2      65.3      65.2
65.0      65.4       69.7      65.4      65.1
64.9      65.1       67.8      65.5      65.1
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65.1     65.1      67.0     65.5     65.1
65.0     65.1      66.7     65.6     65.1

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 65.502    65.513    65.404
THETA1=        1.0000000
THETA2=         .3916121
THETA3=         .2196969
THETA4=         .1464698
THETA5=         .1167443

H=  105.089 W/m2C                ReH=  4755.9020000
NUSSELT#=153.273
FREESTREAM VELOCITY =  3.020 m/s=  9.908 ft/s
Qin=  6.872 Watts   Qloss=   .256 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 18.596 C           VISCOSITY= .00003710 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     18.4         18.4           18.5         18.7         18.6
     18.4         18.5           18.4         18.3         18.5
     18.4         18.5           20.1         18.5         18.3
     18.4         18.5           69.3         18.6         18.5
     18.5         18.4           24.5         18.5         18.4
     18.3         18.5           20.9         18.6         18.4
     18.3         18.4           19.9         18.6         18.4
     18.4         18.4           19.5         18.6         18.4
     18.3         18.4           19.3         18.7         18.4


THE HEATED CUBE IS IN COLUMN 3 AND ROW  5
BAROMETRIC PRESSURE   29.884 INCHES OF Hg
PITOT-STATIC TUBE DELTA .02200 INCHES WATER
VOLTS  3.5980      AMPS  1.8000
CHANNEL HEIGHT RATIO 4.6

THE INPUT TEMPERATURE ARRAY IN DEGREES F
65.5     65.5      65.4     65.6     65.5
65.4     65.4      65.2     65.2     66.2
65.9     66.0      65.9     66.0     65.7
65.6     65.6      68.9     70.2     69.9
70.2     69.8     158.7     69.6     69.7
69.3     69.4      79.7     65.4     65.5
65.2     65.5      69.9     65.6     65.4
65.5     65.5      68.6     65.8     65.8
65.7     65.8      68.2     66.1     65.9

CALIBRATED TEMPERATURES IN DEGREES F
63.7     63.7      63.7     63.9     63.8
63.6     63.8      63.7     63.7     64.0
63.7     63.9      63.8     64.0     63.7
63.6     63.7      66.9     64.2     63.9
64.2     64.0     154.4     63.8     64.0
63.5     63.8      74.1     63.9     63.9
63.6     63.8      67.9     63.9     63.8
63.7     63.8      66.3     63.9     63.9
63.6     63.8      66.0     64.2     63.9

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 63.700    63.703    63.700
THETA1=        1.0000000
THETA2=         .4054705
THETA3=         .2532205
THETA4=         .2228174

H=   99.676 W/m2C                ReH=  4744.3410000
NUSSELT#=145.654
FREESTREAM VELOCITY =  3.004 m/s=  9.855 ft/s
Qin=  6.476 Watts   Qloss=   .255 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 17.612 C           VISCOSITY= .00003699 m2/s
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SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     17.6          17.6           17.6          17.7          17.7
     17.6          17.7           17.6          17.6          17.8
     17.6          17.7           17.7          17.8          17.6
     17.6          17.6           19.4          17.9          17.7
     17.9          17.8           68.0          17.7          17.8
     17.5          17.7           23.4          17.7          17.7
     17.5          17.7           20.0          17.7          17.6
     17.6          17.6           19.1          17.7          17.7
     17.6          17.6           18.9          17.9          17.7


THE HEATED CUBE IS IN COLUMN 3 AND ROW  6
BAROMETRIC PRESSURE   29.666 INCHES OF Hg
PITOT-STATIC TUBE DELTA .02200 INCHES WATER
VOLTS  2.9110     AMPS  2.1000
CHANNEL HEIGHT RATIO 4.6

THE INPUT TEMPERATURE ARRAY IN DEGREES F
66.8     66.8      66.7     66.9     66.8
66.6     66.7      66.5     66.4     67.4
67.2     67.3      67.1     67.2     66.9
66.9     66.9      66.9     71.4     71.1
71.5     71.0      72.6     70.8     70.8
70.7     70.8     154.8     66.6     66.7
66.4     66.7      73.5     66.9     66.6
66.8     66.7      68.8     67.1     67.0
66.9     67.1      69.0     67.4     67.1

CALIBRATED TEMPERATURES IN DEGREES F
65.3     65.2      65.2     65.4     65.3
65.1     65.2      65.1     64.8     65.2
65.0     65.2      65.0     65.2     64.8
65.1     65.1      64.9     65.3     65.1
65.5     65.1      66.7     65.0     64.9
65.0     65.3     150.2     65.0     65.0
64.8     64.9      71.8     65.1     65.0
65.0     65.0      66.8     65.2     65.0
64.9     65.1      66.8     65.3     65.0

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 65.502    65.311    66.106
THETA1=        1.0000000
THETA2=         .1940702
THETA3=         .1912994

H=  100.879 W/m2C                  ReH=  4755.3540000
NUSSELT#=147.107
FREESTREAM VELOCITY =  3.021 m/s=  9.910 ft/s
Qin=  6.113 Watts   Qloss=   .238 Watts    CONDUCTIVITY=   .040 W/mC
TAMB= 18.689 C           VISCOSITY= .00003711 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     18.5          18.5           18.5          18.6          18.5
     18.4          18.5           18.4          18.2          18.4
     18.3          18.4           18.3          18.4          18.2
     18.4          18.4           18.3          18.5          18.4
     18.6          18.4           19.3          18.3          18.3
     18.3          18.5           65.7          18.3          18.3
     18.2          18.3           22.1          18.4          18.3
     18.3          18.3           19.4          18.4          18.3
     18.3          18.4           19.3          18.5          18.3


THE HEATED CUBE IS IN COLUMN 3 AND ROW  1
BAROMETRIC PRESSURE   30.024 INCHES OF Hg
PITOT-STATIC TUBE DELTA .04900 INCHES WATER
VOLTS  4.1140     AMPS  2.0000
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CHANNEL HEIGHT RATIO 4.6

THE INPUT TEMPERATURE ARRAY IN DEGREES F
72.3     72.3     150.4     72.7     72.4
72.3     72.3      77.9     72.0     72.9
72.7     72.8      75.7     72.9     72.4
72.4     72.4      74.6     77.2     76.6
76.7     76.5      78.2     76.7     76.3
76.2     76.3      77.5     72.5     72.2
72.0     72.3      73.2     72.7     72.1
72.3     72.2      73.3     72.8     72.5
72.4     72.6      73.4     72.9     72.6

CALIBRATED TEMPERATURES IN DEGREES F
70.7     70.7     149.0     71.1     70.9
70.8     71.0      76.7     70.7     70.9
70.7     70.9      73.8     71.2     70.5
70.7     70.9      72.9     71.4     70.8
71.0     70.8      72.7     71.1     70.8
70.7     70.9      72.2     71.3     70.8
70.8     70.9      71.8     71.3     70.8
70.8     70.8      71.8     71.2     70.7
70.7     71.0      71.5     71.1     70.8

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 70.811    70.904    70.820
THETA1=        1.0000000
THETA2=         .5129483
THETA3=         .3467078
THETA4=         .3196545
THETA5=         .2300852
THETA6=         .1672513
THETA7=         .1568281
THETA8=         .1163621

H=  146.870 W/m2C                 ReH=  7029.2110000
NUSSELT#=212.992
FREESTREAM VELOCITY =  4.503 m/s= 14.774 ft/s
Qin=  8.228 Watts   Qloss=   .220 Watts    CONDUCTIVITY=   .040 W/mC
TAMB= 21.581 C           VISCOSITY= .00003742 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     21.5          21.5          65.0          21.7          21.6
     21.6          21.7          24.8          21.5          21.6
     21.5          21.6          23.2          21.8          21.4
     21.5          21.6          22.7          21.9          21.6
     21.7          21.6          22.6          21.7          21.6
     21.5          21.6          22.3          21.8          21.5
     21.5          21.6          22.1          21.8          21.5
     21.6          21.6          22.1          21.8          21.5
     21.5          21.7          22.0          21.7          21.6


THE HEATED CUBE IS IN COLUMN 3 AND ROW  2
BAROMETRIC PRESSURE   29.666 INCHES OF Hg
PITOT-STATIC TUBE DELTA .05000 INCHES WATER
VOLTS  3.8380     AMPS  1.8700
CHANNEL HEIGHT RATIO 4.6

THE INPUT TEMPERATURE ARRAY IN DEGREES F
67.1     67.1      68.4     67.5     67.3
67.0     67.3     135.3     66.9     67.7
67.6     67.8      72.8     67.6     67.2
67.2     67.3      69.9     71.8     71.3
71.6     71.4      73.2     71.4     71.2
71.1     71.2      72.5     67.2     67.1
66.9     67.1      68.1     67.4     66.9
67.2     67.1      68.2     67.5     67.4
67.4     67.5      68.4     67.7     67.5
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CALIBRATED TEMPERATURES IN DEGREES F
65.6      65.5       67.0      66.0      65.8
65.5      65.8      134.5      65.3      65.5
65.4      65.7       70.7      65.6      65.1
65.4      65.5       68.0      65.7      65.3
65.6      65.5       67.3      65.6      65.4
65.4      65.7       66.9      65.6      65.4
65.3      65.3       66.4      65.6      65.3
65.4      65.4       66.2      65.6      65.4
65.4      65.5       66.2      65.6      65.4

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 65.803    65.815    65.705
THETA1=          1.0000000
THETA2=           .4394598
THETA3=           .3148502
THETA4=           .2341962
THETA5=           .1314742
THETA6=           .0934434
THETA7=           .0905195

H=  145.763 W/m2C                 ReH=  7168.2990000
NUSSELT#=212.528
FREESTREAM VELOCITY =  4.554 m/s= 14.941 ft/s
Qin=  7.177 Watts   Qloss=    .193 Watts     CONDUCTIVITY=    .040 W/mC
TAMB= 18.764 C            VISCOSITY= .00003712 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     18.7         18.6           19.4         18.9         18.8
     18.6         18.8           56.9         18.5         18.6
     18.6         18.7           21.5         18.7         18.4
     18.6         18.6           20.0         18.7         18.5
     18.6         18.6           19.6         18.7         18.5
     18.5         18.7           19.4         18.7         18.5
     18.5         18.5           19.1         18.7         18.5
     18.6         18.5           19.0         18.7         18.6
     18.6         18.6           19.0         18.7         18.6


THE HEATED CUBE IS IN COLUMN 3 AND ROW  3
BAROMETRIC PRESSURE   29.884 INCHES OF Hg
PITOT-STATIC TUBE DELTA .04950 INCHES WATER
VOLTS  3.4230      AMPS  1.8000
CHANNEL HEIGHT RATIO 4.6

THE INPUT TEMPERATURE ARRAY IN DEGREES F
65.8      65.8       65.8      66.1      65.9
65.7      65.7       67.1      65.5      66.6
66.4      66.7      135.3      66.4      66.2
65.9      66.0       72.5      70.6      70.2
70.2      70.1       73.3      70.1      70.0
69.7      69.7       71.8      65.9      65.8
65.5      65.8       67.3      66.0      65.8
65.8      65.8       67.2      66.2      66.1
66.0      66.2       67.3      66.4      66.2

CALIBRATED TEMPERATURES IN DEGREES F
64.0      64.0       64.1      64.4      64.2
63.9      64.1       65.6      64.0      64.4
64.2      64.6      133.7      64.4      64.2
63.9      64.1       70.6      64.6      64.2
64.2      64.3       67.5      64.3      64.3
63.9      64.1       66.1      64.4      64.2
63.9      64.1       65.3      64.3      64.2
64.0      64.1       64.9      64.3      64.2
63.9      64.2       65.1      64.5      64.2

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
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 64.101    64.005    64.102
THETA1=        1.0000000
THETA2=         .5336164
THETA3=         .3166398
THETA4=         .1934063
THETA5=         .1327974
THETA6=         .1620259

H=  123.447 W/m2C                    ReH=  7114.6970000
NUSSELT#=180.318
FREESTREAM VELOCITY =  4.507 m/s= 14.788 ft/s
Qin=  6.161 Watts   Qloss=   .196 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 17.816 C            VISCOSITY= .00003701 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     17.8          17.8           17.9          18.0          17.9
     17.7          17.9           18.7          17.8          18.0
     17.9          18.1           56.5          18.0          17.9
     17.7          17.9           21.4          18.1          17.9
     17.9          17.9           19.7          17.9          18.0
     17.7          17.8           19.0          18.0          17.9
     17.7          17.9           18.5          17.9          17.9
     17.8          17.8           18.3          17.9          17.9
     17.7          17.9           18.4          18.0          17.9


THE HEATED CUBE IS IN COLUMN 3 AND ROW  4
BAROMETRIC PRESSURE   29.884 INCHES OF Hg
PITOT-STATIC TUBE DELTA .04950 INCHES WATER
VOLTS  3.9510     AMPS  1.8000
CHANNEL HEIGHT RATIO 4.6

THE INPUT TEMPERATURE ARRAY IN DEGREES F
65.7     65.7      65.7     65.9     65.8
65.5     65.5      65.5     65.5     66.4
66.3     66.4      68.3     66.3     66.2
65.9     65.8     146.9     70.2     70.0
70.0     69.9      78.2     69.9     69.9
69.6     69.5      73.0     65.6     65.7
65.4     65.6      67.9     65.9     65.6
65.7     65.6      67.6     66.1     65.9
65.8     65.9      67.5     66.3     66.1

CALIBRATED TEMPERATURES IN DEGREES F
63.9     63.9      64.0     64.2     64.1
63.7     63.9      64.0     64.0     64.2
64.1     64.3      66.2     64.3     64.2
63.9     63.9     145.4     64.2     64.0
64.0     64.1      72.5     64.1     64.2
63.8     63.9      67.3     64.1     64.1
63.8     63.9      65.9     64.2     64.0
63.9     63.9      65.3     64.2     64.0
63.7     63.9      65.3     64.4     64.1

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 63.901    63.804    63.901
THETA1=        1.0000000
THETA2=         .4013845
THETA3=         .2378280
THETA4=         .1694369
THETA5=         .1680405

H=  121.774 W/m2C                    ReH=  7115.6870000
NUSSELT#=177.913
FREESTREAM VELOCITY =  4.507 m/s= 14.785 ft/s
Qin=  7.112 Watts   Qloss=   .229 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 17.705 C            VISCOSITY= .00003700 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
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          17.7          17.7           17.8          17.9          17.8
          17.6          17.7           17.8          17.8          17.9
          17.8          17.9           19.0          17.9          17.9
          17.7          17.7           63.0          17.9          17.8
          17.8          17.8           22.5          17.8          17.9
          17.6          17.7           19.6          17.8          17.8
          17.7          17.7           18.8          17.9          17.8
          17.7          17.7           18.5          17.9          17.8
          17.6          17.7           18.5          18.0          17.8


THE HEATED CUBE IS IN COLUMN 3 AND ROW  5
BAROMETRIC PRESSURE   29.884 INCHES OF Hg
PITOT-STATIC TUBE DELTA .04900 INCHES WATER
VOLTS  3.5260      AMPS  1.8400
CHANNEL HEIGHT RATIO 4.6

THE INPUT TEMPERATURE ARRAY IN DEGREES F
65.5       65.5       65.6       65.7       65.6
65.6       65.5       65.5       65.4       66.3
66.1       66.1       66.2       66.0       66.1
65.9       65.7       68.3       70.2       70.1
70.2       69.9      146.0       69.9       69.8
69.6       69.4       77.4       65.5       65.6
65.3       65.6       68.9       65.7       65.6
65.5       65.5       68.0       65.9       65.9
65.8       65.9       65.9       66.1       66.0

CALIBRATED TEMPERATURES IN DEGREES F
63.7       63.7       63.9       64.0       63.9
63.8       63.9       64.0       63.9       64.1
63.9       64.0       64.1       64.0       64.1
63.9       63.8       66.3       64.2       64.1
64.2       64.1      141.5       64.1       64.1
63.8       63.8       71.8       64.0       64.0
63.7       63.9       66.9       64.0       64.0
63.7       63.8       65.7       64.0       64.0
63.7       63.9       63.7       64.2       64.0

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 63.901    63.703    62.898
THETA1=        1.0000000
THETA2=         .4130622
THETA3=         .2696180
THETA4=         .0265265

H=  116.136 W/m2C                   ReH=  7081.4630000
NUSSELT#=169.742
FREESTREAM VELOCITY =  4.482 m/s= 14.705 ft/s
Qin=  6.488 Watts   Qloss=   .219 Watts    CONDUCTIVITY=   .040 W/mC
TAMB= 17.501 C            VISCOSITY= .00003698 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     17.6          17.6           17.7          17.8          17.7
     17.7          17.7           17.8          17.7          17.8
     17.7          17.8           17.8          17.8          17.8
     17.7          17.7           19.1          17.9          17.8
     17.9          17.8           60.8          17.8          17.9
     17.6          17.7           22.1          17.8          17.8
     17.6          17.7           19.4          17.8          17.8
     17.6          17.6           18.7          17.8          17.8
     17.6          17.7           17.6          17.9          17.8


THE HEATED CUBE IS IN COLUMN 3 AND ROW  6
BAROMETRIC PRESSURE   29.884 INCHES OF Hg
PITOT-STATIC TUBE DELTA .04900 INCHES WATER
VOLTS  2.7780      AMPS  2.0500
CHANNEL HEIGHT RATIO 4.6
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THE INPUT TEMPERATURE ARRAY IN DEGREES F
65.4     65.4      65.5     65.5     65.4
65.4     65.2      65.3     65.3     66.1
65.9     65.9      65.9     65.9     65.9
65.7     65.6      65.7     69.9     69.8
69.9     69.7      70.9     69.6     69.6
69.4     69.2     135.7     65.3     65.5
65.2     65.3      69.9     65.4     65.4
65.4     65.3      67.7     65.7     65.7
65.6     65.8      67.2     65.8     65.8

CALIBRATED TEMPERATURES IN DEGREES F
63.6     63.6      63.8     63.8     63.7
63.6     63.6      63.8     63.8     63.9
63.7     63.8      63.8     63.9     63.9
63.7     63.7      63.7     63.9     63.8
63.9     63.8      65.1     63.8     63.9
63.6     63.6     130.8     63.8     63.9
63.6     63.6      67.9     63.7     63.8
63.6     63.6      65.4     63.8     63.8
63.5     63.8      65.0     63.9     63.8

AMBIENT TEMPERATURE CALIBRATED IN FAHR.
 63.700    63.602    63.700
THETA1=       1.0000000
THETA2=        .4149780
THETA3=        .3180087

H=  118.417 W/m2C               ReH=  7080.6430000
NUSSELT#=173.046
FREESTREAM VELOCITY =  4.483 m/s= 14.708 ft/s
Qin=  5.695 Watts   Qloss=   .189 Watts     CONDUCTIVITY=   .040 W/mC
TAMB= 17.593 C          VISCOSITY= .00003699 m2/s

SMOOTH TEMPERATURE ARRAY IN DEGREES CENTIGRADE
     17.6         17.6           17.7         17.7         17.6
     17.6         17.6           17.7         17.7         17.7
     17.6         17.6           17.7         17.7         17.7
     17.6         17.6           17.6         17.7         17.7
     17.7         17.7           18.4         17.7         17.7
     17.5         17.5           54.9         17.7         17.7
     17.5         17.6           20.0         17.6         17.6
     17.6         17.5           18.6         17.7         17.7
     17.5         17.6           18.3         17.7         17.7
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